Hope Bay Mining Limited

DORIS NORTH GOLD MINE PROJECT
Hydrology Compliance Report 2012

NEWMONT™ NORTH AMERICA

Rescan™ Engineers & Scientists

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DORIS NORTH GOLD MINE PROJECT
HYDROLOGY COMPLIANCE REPORT 2012

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Executive Summary

Engineers and Scientists

Executive Summary

The purpose of this report is to present the results from the 2012 Hydrology Compliance Monitoring Program for the Doris North Project. Lake and stream water levels were monitored at stations TL-2 (Doris Creek upstream location), TL-3 (Doris Creek downstream location), Windy Hydro (Windy Lake outflow), Roberts Hydro (Roberts Lake outflow), Doris Lake, and Tail Lake in order to comply with the Doris North Project Certificate (NIRB No. 003 2006) and the Type A Water License requirements (NWB No. 2AM-DOH0713 2007). The hydrometric monitoring program also supported work required by the Tail Lake Outflow Fisheries Authorization (NU-02-0117.3) and the No Net Loss Plan Updates (Rescan 2010). Additionally, water levels were monitored at Roberts Bay to fulfill the requirements of the Roberts Bay Jetty Authorization (NU-02-0117).

The hydrometric monitoring program commenced in early June and continued until mid-September, when stations Doris TL-2, Doris TL-3, Windy Hydro, Roberts Hydro, and Roberts Bay were demobilized for the winter. The hydrometric stations at Doris and Tail lakes remain in operation and will continue recording data through the 2012 - 2013 winter season.

During the open water season (June to September), the lake water level variation for Doris Lake was 0.626 m, ranging from a minimum of 97.830 m on September 7 to a maximum of 98.456 m on June 13. A single peak water level was measured in Doris Lake in 2012, occurring as a result of snow and ice melt during freshet. After the freshet peak, lake water levels declined steadily, with the exception of a slight, temporary increase in response to a rainfall event (12.95 mm) that occurred on July 22.

At Tail Lake, water level during the open water season ranged from 93.986 m on September 12 to 94.482 m on June 12, for a total variation of 0.495 m. A single peak water level was recorded during freshet. After that date, water level declined steadily until late July, when several rain events caused a slight increase. Water level continued to decline until late August, when rainfall caused another increase. The magnitude of rainfall-induced recharge may have been offset by pumping from Tail Lake, which commenced on June 11 and continued until the Doris TL-2 hydrometric station was demobilized on September 13.

At Windy Lake, water level variation was 0.18 m, less than that observed at Doris and Tail Lakes. Water level increased rapidly from June 6 (the date of station remobilization) to June 9, then remained elevated during the rest of June, reaching a peak of 95.143 on June 23. After freshet, water level in Windy Lake declined until late August, when recharge occurred briefly as a result of late summer and early fall rain events. Water level continued to decline in early September. The lowest level recorded for 2012 was 94.963 on September 12, measured immediately before the station was demobilized for winter.

Tidal fluctuations were recorded by an automated station located approximately 90 m east of the existing jetty. The tides in Roberts Bay were microtidal (less than 2 m in tide range). Daily water level ranges (calculated for each lunar day of 24 hours and 50 minutes) were generally between 0.2 m and 0.3 m, with an average of 0.26 m ± 0.06 m.

The maximum tidal range is defined by the difference between high and low water levels in one tidal cycle. During the monitoring period, the maximum tidal range of 0.51 m occurred during a spring tide on August 1, 2012.

Calculated runoff values for the period of record in 2012 were 104 mm for Doris TL-2, 105 mm for Doris TL-3, 98 mm for Roberts Hydro, and 112 mm for Windy Hydro. Calculated mean flows for the 2012 period of record were 1.16 m^3/s for Doris TL-2, 1.23 m^3/s for Doris TL-3, 1.16 m^3/s for Roberts Hydro, and 0.22 m^3/s for Windy Hydro. Comparatively, 2012 was a drier year than 2010 and 2011 in terms of annual runoff and mean discharge.

The onset of the spring freshet occurred in early June. Water levels in the monitored streams reached an annual peak in mid- to late-June as a result of ice- and snowmelt. Discharges at Doris TL-2, Doris TL-3, and Roberts Hydro declined steadily after freshet. Discharge at Windy Hydro declined until mid-July, when it underwent a slight, temporary increase in response to several rain events. During a dry period in late July and early August, discharge at Windy Hydro continued to decrease until August 22 - 28, when rainfall recharged Windy Lake. After this rainy period in late August, discharge continued to decrease. Daily peak flows were 3.56 m^3/s at Doris TL-2, 3.78 m^3/s at Doris TL-3, 3.6 m^3/s at Roberts Hydro, and 0.36 m^3/s at Windy Hydro.

At all monitoring stations, the lowest annual flows were measured in early September, immediately prior to station demobilization for winter. Low flows during the period of record were 0.138 m^3/s at Doris TL-2, 0.174 m^3/s at Doris TL-3, 0.107 m^3/s at Roberts Hydro, and 0.057 m^3/s at Windy Hydro.

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Glossary and Abbreviations

Glossary and Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

ADCP	Acoustic Doppler Current Profiler
Runoff	Runoff is the part of precipitation that appears in surface streams and is a measure of hydrologic response of a watershed. It is the quantity of water that is discharged ("runs off") from a watershed during a given time period. It is commonly presented as a depth of water over an entire watershed, in mm.
Freshet	In channels, the relatively high annual peak water discharge period resulting from spring/summer meltwater runoff of the snowpack accumulated over the winter.
HBML	Hope Bay Mining Limited
Hydrograph	A graphical plot of water discharge versus time.
ISO	International Organization for Standardization
NAD 83	North American Datum 1983. A datum is a reference system for computing or correlating the results of a survey. The NAD83 datum is based on the spheroid (GRS80).
NWB	Nunavut Water Board
RMS	Root Mean Square, a statistical measure of the differences between modeled and observed values.
Stage	The depth of water in a water course or channel
Stage-Discharge Curve (Rating Curve)	A curve derived from concurrently measured stage and discharge data that is used to estimate the discharge for any given observed stage at a hydrometric station. Often referred to as a rating curve.

1. Introduction

1. Introduction

The Doris North Project (the Project) is located approximately 125 km southwest of Cambridge Bay, Nunavut, on the south shore of Melville Sound (Figure 1-1). Construction of the Project has been underway since 2010, but Hope Bay Mining Limited (HBML) announced on January 31, 2012, that the Project would be placed into Care and Maintenance. The Doris Camp was closed down in October of 2012 for the winter, and current plans are to open the camp only seasonally in order to conduct water management activities.

The purpose of this report is to present the results from the 2012 Hydrology Compliance Monitoring Program for the Project.

During the Hydrology Compliance Monitoring Program, water level data were collected in order to comply with the following regulatory requirements:

- Doris North Project Type A Water Licence (NWB No. 2AM-DOH0713; issued September 19, 2007):
  - Part F, Item 1a: "(the Water Management Plan should include) A requirement to continuously monitor Doris Lake levels and outflow during the two (2) years of mining and beyond to confirm water balance model predictions."
  - Part G, Item 29. "The Licensee shall ensure that water within the Tailings Impoundment Area is maintained at an elevation of least 28.3 metres above sea level such that a minimum of four (4) metres of water cover is maintained over the tailings at all times."
  - Part G, Item 30. "The Licensee shall ensure that the flow from the Tailings Impoundment Area into Doris Creek at monitoring station TL-4 does not exceed 10% of the background flow in Doris Creek as measured at monitoring station TL-2 at the time of discharge."
  - Part J, Item 2: "The Licensee shall install appropriate instrumentation in Doris Creek at Monitoring Station TL-2, to monitor flow when ice conditions allow for such measurements to be taken, on a real time and continuous basis."
  - Part J, Item 3. "The Licensee shall undertake the Water Monitoring Program detailed in the Tables of Schedule J."
- Doris North Project Certificate (NIRB No. 003, issued September 15, 2006):
  - "Hope Bay Mining Limited will monitor stage and discharge in Doris Outflow both upstream and downstream of the decant discharge point to provide information that can be used in assessing the accuracy of the impact predictions relating to fish habitat downstream."

In addition to the hydrometric monitoring required for the Type A Water Licence and Project Certificate, monitoring was also conducted in 2012 at the Windy Lake, Roberts Hydro, and Roberts Bay stations to support work required by the Tail Lake Outflow Fisheries Authorization (NU-02-0117.3), the Roberts Bay Jetty Authorization (NU-02-0117), and the No Net Loss Plan Updates (Golder 2007, Rescan 2010).

The construction of the North Dam for the future Tailings Impoundment Area commenced in January 2011 and continued throughout the spring and summer seasons. In July 2011, high spring runoff and impounded water levels on the upstream side of the North Dam became a concern with respect to the integrity of the structure during the construction period. As a result, Hope Bay Mining Limited (HBML) obtained permission to transfer fresh waters that were contained by the dam downstream to Doris Creek. In response, a daily hydrology compliance monitoring program was initiated in 2011 and continued in 2012 at station TL-2 in order to assure compliance with Part 6, Item 3 of the Type A Water Licence.

Figure 1-1

Doris North Project Location

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The daily hydrology monitoring program along Doris Creek consisted of converting continually recorded surface water elevations at station TL-2 to volumetric water discharge estimates. From this, the maximum amount of stored water volume that could be transferred from Tail Lake to Doris Creek was determined so that the daily water transfer rate did not exceed 10% of the determined background flow along Doris Creek. Details of the hydrology monitoring program at compliance station TL-2 are provided in Appendix D of this report.

Chapter 2 of this report presents the methods used to collect and analyze hydrometric data. Chapter 3 presents the results from the 2012 monitoring program for the following seven stations:

- Doris TL-2 (Doris Creek upstream);
- Doris TL-3 (Doris Creek downstream);
- Windy Hydro (Windy Lake outflow);
- Roberts Hydro (Roberts Lake outflow);
- Doris Lake;
- Tail Lake; and
- Roberts Bay.

2. Methods

2. Methods

Methods from the 2012 Hydrology Compliance Monitoring Program are presented as follows: 1) description of the monitoring network, 2) hydrometric station setups, 3) hydrometric levelling surveys, 4) discharge measurements, 5) rating curve development, 6) hydrograph generation, and 7) calculation of hydrological indices.

2.1 HYDROLOGY COMPLIANCE MONITORING NETWORK

In 2012 the hydrology compliance monitoring network consisted of seven stations that operated in the Doris North Mine area (Figure 2.1-1 and Table 2.1-1).

Table 2.1-1. Compliance Hydrometric Monitoring Stations in the Doris North Project Area for 2012

Hydrometric Station	Geographic Location	UTM Coordinates (Zone 13 W)		Drainage Area (km^2)	Period of Operation	Hydrometric Monitoring	Purpose
		Easting	Northing				
TL-2 (Doris Creek upstream location)	Doris Lake outflow	434,059	7,559,504	94.6	June 9 - September 13	Real-time continuous monitoring of water levels; Periodic flow measurements	Gauge flow required for Type A Water Licence
TL-3 (Doris Creek downstream location)	Doris Creek, downstream of Doris Falls	434,204	7,559,985	95.3	June 10 - September 10	Continuous monitoring of water levels; Periodic flow measurements	Gauge flow required for Type A Water Licence
Roberts Hydro	Roberts Lake outflow	435,310	7,562,560	97.9	June 7 - September 11	Continuous monitoring of water levels; Periodic flow measurements	Support requirements for Fisheries Authorization (NU-02-0117)
Windy Hydro	Northwest shore of Windy Lake	431,481	7,555,089	14.1	June 6 - September 12	Continuous monitoring of water levels; Periodic flow measurements	Water level data will support habitat compensation project as required by Fisheries Authorization (NU-02-0117.3)
Tail Lake	Northwest shore of Tail Lake	434,832	7,558,560	4.2	January 1 - December 31	Continuous monitoring of water levels	Monitoring required for Type A Water Licence
Doris Lake	Northwest shore of Doris Lake	433,512	7,558,452	94.6	January 1 - December 31	Continuous monitoring of water levels	Monitoring required for Type A Water Licence
Tide Gauge (Roberts Bay)	Roberts Bay, approximately 90 m east of existing jetty	432,612	7,563,336	*n/a*	July 28 - September 13	Continuous monitoring of water levels	Support bathymetry requirements for (NU-02-0117)

n/a - not applicable

The automated monitoring stations located at Doris and Tail lakes were partially operated through 2004 at temporary locations, before they were permanently installed at their current locations in 2005. These stations operated through the 2011/2012 winter season and remained in operation as of the last site visit in September 2012.

The monitoring stations TL-2 (Doris Creek upstream), TL-3 (Doris Creek downstream), Roberts Hydro, and Windy Hydro were remobilized at the onset of freshet between June 4 and June 15, 2012. The tide gauge located at Roberts Bay was remobilized on July 28, 2012.

All stations, with the exception of the two stations located at Doris and Tail lakes, were demobilized in mid-September to prevent ice damage to the pressure transducers.

2.2 HYDROMETRIC STATION SETUP

All the automatic hydrometric stations consisted of a pressure transducer and data logger combination. The instrumentation recorded water level data, or stage, at specific time intervals. The station setup varied among the different stations operating within the project area. The following is a description of the setups used in the 2012 monitoring program.

The stations located at Doris and Tail lakes consisted of a 10 psi vented KPSI 730-series solid-state pressure transducer (Measurement Specialties Inc.) paired with a DD-320 data logger (Optimum Instruments Inc.). The data logger recorded lake water levels every 15 minutes. The pressure transducer and cabling were inserted through a 10 cm diameter steel pipe anchored to an on-shore bedrock outcrop; the pipe was set in the lake to a depth below 5 m to prevent freezing during the winter months. The data logger was housed in a steel enclosure located along the lake shoreline above the high water mark.

The hydrometric station TL-2 (Doris Creek upstream) instrumentation package consisted of a 0 - 5 psi vented PS-9800® pressure transducer (Instrumentation Northwest Inc.) paired with an HOBO® Energy Pro Datalogger (Onset Computer Corp). It also included a Solarstream™ solar-powered Iridium® satellite transceiver (Upward Innovations Inc.). Every two hours the system automatically sent the recorded water level data to a secure Internet server. Data were then available for viewing or downloading over a secure 256-bit encrypted connection. The pressure transducer and cabling were inserted into a flexible aluminum conduit with one end of the conduit attached to a piece of angle iron 1.5 m long. The angle iron assembly was weighed down and placed flat on the streambed as deep as possible in the water to allow for monitoring of low stream levels. The sensor, datalogger, and satellite transceiver were housed in a polycarbonate waterproof enclosure. Power to the station was supplied by a 12 Volt battery connected to a backup solar panel. All the instrumentation was mounted to a 3.0 m-tall galvanized steel tripod located along the adjacent channel bank above the high water mark (see Plate 2.2-1).

The stations TL-3 (Doris Creek downstream), Roberts Hydro, and Windy Hydro were standard hydrometric stations. The setup at these stations consisted of a 0-5 psi vented Aquistar PT-2X Smart Sensor® (Instrumentation Northwest Inc.). This sensor combines the pressure transducer and data logger in a small diameter unit. The unit recorded water level at 10 minute intervals. The sensor and cabling were inserted into a flexible aluminum conduit with one end of the conduit attached to a piece of angle iron 1.5 m long. In rocky substrates the angle iron was placed directly on the lakebed or streambed, whereas in fine-grained substrates the angle iron was attached to a wooden frame to spread the weight evenly and prevent the assembly from sinking into the substrate.

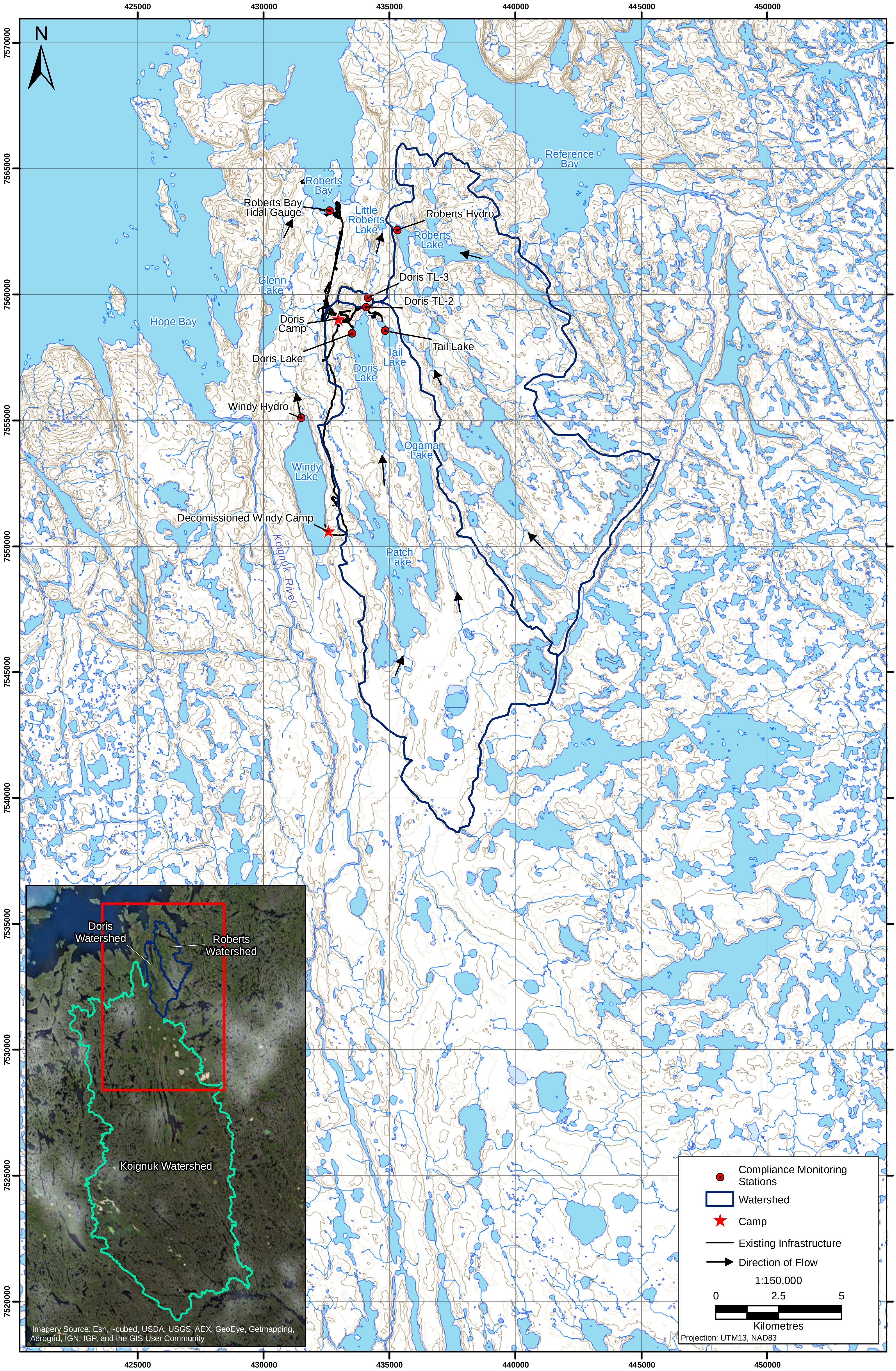

Figure 2.1-1

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2012 Compliance Monitoring Stations, Doris North Project

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Figure 2.1-1

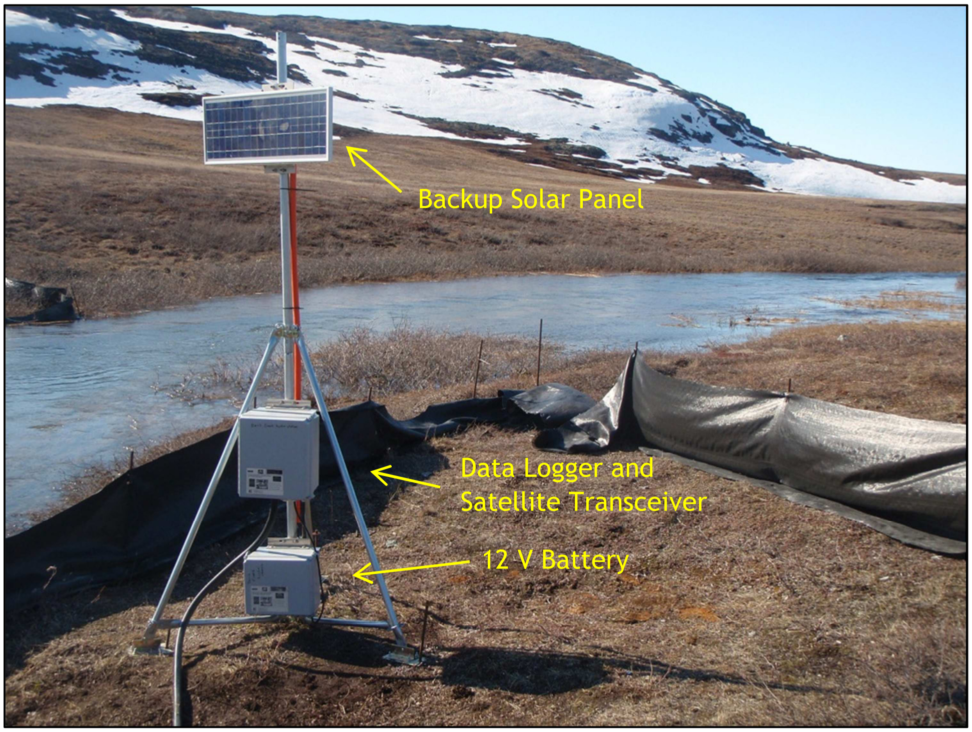


Plate 2.2-1. View downstream (northwest) along Doris Creek showing the satellite telemetry instrumentation used at hydrometric station Doris TL-2. June 9, 2012.

The tidal gauge station operated at Roberts Bay consisted of a Levelogger® M-10 pressure transducer/data logger combination (Solinst Canada Ltd.). The Levelogger® was attached to a floating marker and anchored to the ocean bottom. The unit recorded water levels every 10 minutes. A Barologger® (Solinst Canada Ltd.) was installed on shore and recorded atmospheric pressure to correct the Levelogger® absolute pressure readings.

2.3 HYDROMETRIC LEVELLING SURVEYS

2.3.1 Water Level Elevation Surveys

Benchmarks established in 2009 were used as survey control points along the channel banks and lake shores at each of the monitoring stations that were re-established in 2012. At most sites the local datum was assumed to have an elevation of 0.0 m and the main benchmark an arbitrary elevation of 100 m relative to the datum. The exception was at Roberts Bay, where the elevation of the tide gauge was surveyed relative to a pre-established geodetic benchmark. At all stations, the elevations of the pressure transducer and water level relative to the station datum were surveyed using an engineer's rod and level. During subsequent site visits, additional hydrometric levelling surveys were carried out at each station to check and verify pressure transducer readings, as well as to determine the reliability of the water level data that were recorded between site visits.

2.3.2 Shoreline Profile and Channel Geometry Surveys

A shoreline profile survey was conducted at the tide gauge located in Roberts Bay. The purpose of the survey was to determine the ground and nearshore elevational profile so the time series of recorded water elevations could be physically interpreted. Using an engineer's level and stadia rod, the ground elevation was surveyed along a transect from the pre-established geodetic benchmark to the position of the pressure transducer in the bay.

Channel geometry surveys were completed at each hydrometric station (Doris TL-2, Doris TL-3, Roberts Hydro, and Windy Hydro) in order to define the two-dimensional shape and form of the gauged channel cross-section. Channel geometry surveys were conducted using procedures consistent with the current practices of the United States Geological Survey (USGS; Wharton 1994).

At each hydrometric station, a suitable channel reach with a total length of approximately four channel widths was selected, using the station's geographic position as the relative midpoint of the survey. Along the representative reach, three evenly spaced channel cross-sections were surveyed using an engineer's level and stadia rod. Each survey traverse extended across the channel and beyond to it full bankfull width (level of the active floodplain). Cross sections were referenced to an arbitrary local datum that was used to maintain vertical elevational control with the hydrometric station surveys.

2.4 DISCHARGE MEASUREMENTS

At hydrometric stations TL-2 (Doris Creek upstream), TL-3 (Doris Creek downstream), Windy Lake, and Roberts Hydro, current velocity measurements were conducted in order to calculate the water discharges at each station. Measurements were taken throughout the open water season (June to September) to obtain a range of discharges under different flow conditions.

Manual flow measurements were carried out at each site using one of two methods depending on flow conditions and the morphology of the stream. Where streams could be safely waded, a handheld current meter was used. At hydrometric stations where the water depths across the channel were too deep or the flow velocities were too swift to safely to wade, an Acoustic Doppler Current Profiler (ADCP) was used to determine discharge.

2.4.1 Current Velocity Measurements

Under lower flow conditions when stream channels were safe to wade across, current velocity measurements were obtained using a portable electromagnetic velocity flow meter (Hach FH950™). Water discharges were calculated from the stream velocity measurements using the velocity-area method, which determines discharge across the channel between observation verticals. In this method it is assumed that the velocity sampled at each vertical represents the mean velocity in a segment. The segment area extends laterally from half the distance from the preceding vertical to half the distance to the next, and vertically from the water surface to the sounded depth at the channel bed. The partial discharges across the channel are summed to obtain the estimated total discharge measurement for the gauged channel section.

At each vertical section, the water current velocity was measured over a 40 to 70 second time interval in order to obtain the mean velocity for that vertical section. At each sounding point across the channel, if the observed water depth was less than 0.75 m, the current water velocities were measured at 60% of the flow depth of water. The measurement was assumed to be the mean velocity for the vertical water section. When water depths were greater than 0.75 m, current velocities were measured at 20 and 80% of the flow depth of water and the average of the two readings was taken as the mean velocity for the vertical. A minimum of 20 current velocity measurements were taken across the width of the channel, with the aim of having each sounding or measurement interval account for less than 10% of the total discharge. In all cases, the flow measurements satisfied both the Water Survey of Canada (Lane 1999) as well as the British Columbia Manual of Standard Operating Procedures for Hydrometric Surveys (RISC 2009) standard operating procedures.

2.4.2 ADCP Measurements

At stations Doris TL-3 and Roberts Hydro, water depth and velocity conditions were too high during freshet to allow field personnel to safely wade across the channel with a handheld current velocity meter. When these conditions occurred, water discharges were determined using an ADCP. An ADCP determines flow discharges in real-time, based on the measured water current velocities across a channel section. The ADCP-based work was completed following standard operating procedures (Rehmel et al. 2003, WSC 2004a, Oberg et al. 2005) The flow gauging was completed using a StreamPro™ (Teledyne RD Instruments) ADCP unit.

The ADCP unit was mounted onto a tethered floating platform and deployed across the stream by means of a temporary cableway. Measurements of current velocity, water depth, and the position of the unit across the channel section were automatically recorded. A single channel section or transect produced one measurement of mean discharge. At least four valid transects were collected during each site visit to reduce the effects of turbulence, directional bias, or other random errors. Results were considered valid if they were within 5% of the observed mean flow average. The resulting mean discharge value was reported as the estimated discharge for the river. The range of individual measurements was used as the error associated with the average discharge. Transects were reviewed and processed to maintain Quality Assurance/Quality Control (QA/QC) standards. Any values that did not meet specified thresholds were rejected and discarded. Data collection methods followed Water Survey of Canada (WSC) *Procedures for Conducting ADCP Discharge Measurements* (WSC 2004a), while post processing and QA/QC were completed following WSC standard *Procedures for the Review and Approval of ADCP Discharge Measurements* (WSC 2004b).

2.5 RATING CURVE DEVELOPMENT

Unlike water level or stage, discharge is not typically monitored on a continuous basis at most hydrometric stations. To provide a continuous record of the discharge at a monitoring site, a relationship between recorded stages and associated measured discharges is developed. This empirical relationship is referred to as a rating curve (ISO 2010). Once the rating curve is established for a monitoring site, water level data can be converted into a continuous discharge time series or hydrograph.

The quality of a rating curve depends on the number and accuracy of the individual data points used to generate the curve as well as the hydraulic characteristics of the monitoring location. Although a rating curve can be developed with as few as three points, development of a stable rating curve requires 10-15 discharge measurements. Once a stable rating curve is established, a minimum of five discharge measurements per year is recommended to meet “Grade A” standards for discharge data based on the *Manual of British Columbia Hydrometric Standards* (RISC 2009). Each additional stage-discharge measurement at varying flow conditions increases the range and robustness of the rating curve at varying stage-discharge levels. Discharge measurements at the higher end of the discharge range are especially important as they help to define the upper end of the rating curve. These measurements are important as high discharges often require extrapolation beyond the range of the empirical field data used to generate the rating curve. As a function of the channel’s geometry, the rating relationship can also change from low flow periods to high flow periods (Hershey 2009).

In the absence of a stage–discharge measurement corresponding to high flow conditions, the rating curve is often extrapolated to a high flow value that is beyond the range of the observed data used to generate the curve. The stage-discharge relationships in this report were extrapolated to values equal to 1.5 times the greatest measured discharge. Any discharge extrapolation beyond that limit is not recommended as the resulting value will have a high uncertainty associated with it (ISO 2010).

Rating curves were developed using Aquarius™ Time Series Hydrologic Software (Aquatics Informatics Inc.). The software uses standard methods outlined by the United States Geological Survey and the International Organization for Standardization (ISO; Kennedy 1984, ISO 2010). Plotted on a logarithmic scale, a least-squares regression procedure was used to produce a line of best fit and logarithmic equation for the concurrently measured water level (stage) and discharge data. Taking the antilogarithmic transformation, discharge was determined by a power function of the form:

$$Q = C\ (H - a)^{b}$$

where Q is the discharge [m^3/s], C and b are regression coefficients, H is the stage (water level; m), and a is the stage at zero flow (datum correction; m). The stage at zero flow was determined by subtracting the depth of water over the lowest point on the control from the stage indicated by the pressure transducer reading. Cross-sectional channel surveys at all stations provided an approximation of the location of the lowest point on the control, and the location was further refined using estimating techniques built into Aquarius™ Software.

2.6 HYDROGRAPH GENERATION

For each hydrometric station, discharges were calculated by applying the developed rating curves to the recorded stage data for the operational period. It is important to note that the procedure used to generate the discharge hydrograph for station TL-2 was different than the procedure used for stations TL-3 and Roberts Hydro. The hydrograph at TL-2 was updated on a daily basis with the most recent data downloaded via satellite transmissions. Daily discharge data were then sent (via email) to HBML personnel to support the water transfer activities from behind the North Dam to Doris Creek. Details for the procedure used for the hydrograph generation for the station TL-2 are provided in Appendix D.

2.7 HYDROLOGIC INDICES

Calculated hydrologic indices that inform hydrologic assessment for project compliance monitoring are described below.

Calculated annual runoff (expressed as a depth of water) represents the hydrologic difference between annual precipitation, snowmelt, infiltration and evaporation (i.e., a component of the water balance). Runoff is valuable for obtaining gross estimates of the water available in a basin. Because it is standardized by drainage area, it is a useful index when comparing the hydrological response of drainage basins of different sizes.

Mean flow for the period of record is a parameter that provides an indication of the magnitude of water produced as a function of hydroclimatic conditions and drainage basin size.

Peak flows represent the maximum water discharge that is produced by a drainage basin during a year. In the Arctic, peak flows typically occur in response to precipitation and snowmelt events. Peak flows may be used in combination with flood frequency analysis techniques in order to estimate design flows for open channel ditches, diversion channels, or drainage structures at channel crossings. For 2012, the maximum instantaneous and daily flow values were determined from the generated hydrographs.

Low flows provide an estimate of the normal base flow conditions during the open water season, which are important to the sustained health of a stream's aquatic community. Low flows were determined from the generated hydrographs for the period of record between June and September 2012.

3. Results and Observations

3. Results and Observations

Results from the 2012 Hydrology Compliance Monitoring Program are presented as follows: 1) discharge measurements, 2) lake water levels, 3) ocean water levels at Roberts Bay, 4) stage-discharge relationships, 5) discharge hydrographs, and 6) calculated hydrological indices.

3.1 DISCHARGE MEASUREMENTS

A total of 17 manual water discharge measurements were taken in 2012. The measurements were collected throughout the open water season in order to obtain a range of discharges at different flow conditions (Table 3.1-1 and Appendix A).

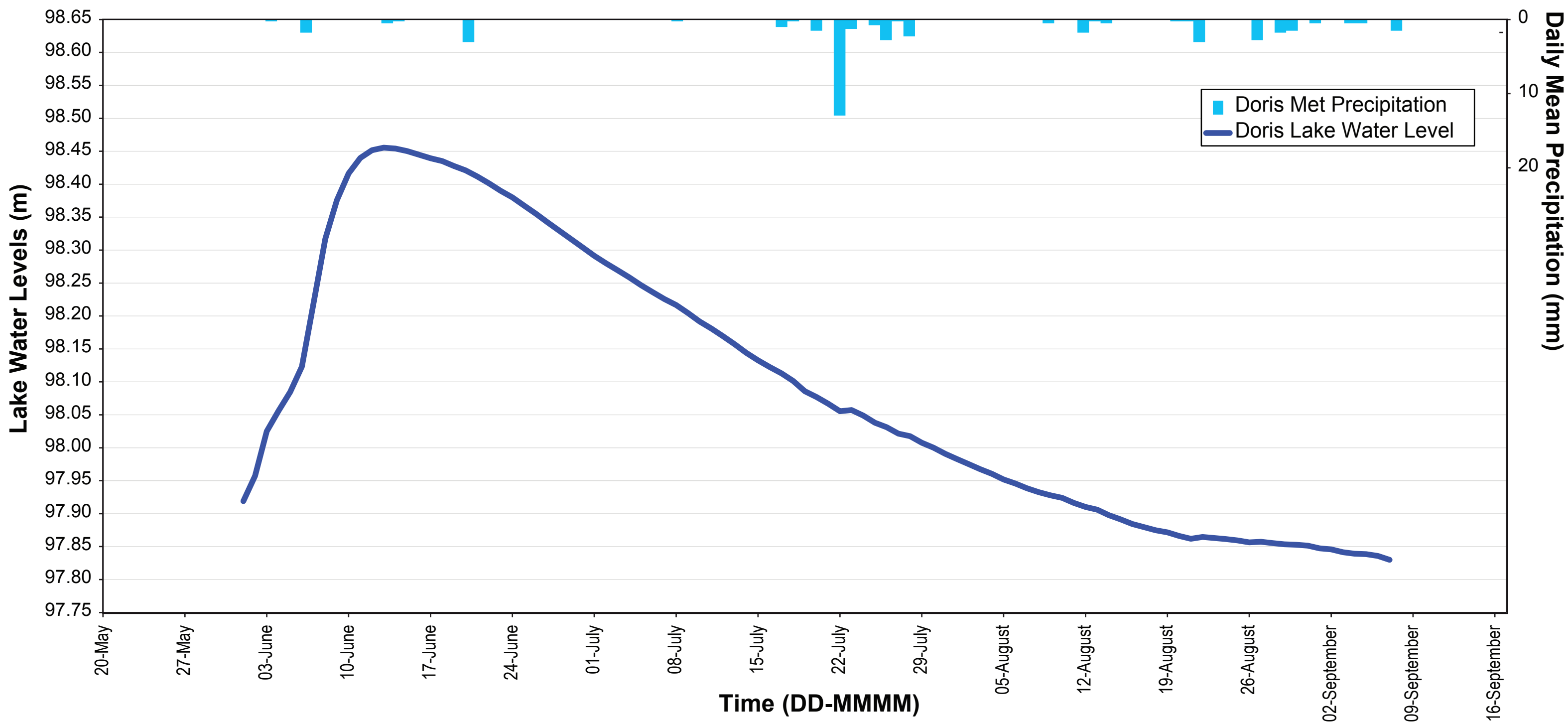
Table 3.1-1. Summary of Manual Flow Discharge Measurements (m^3/s) at Hydrometric Monitoring Stations in the Doris North Project Area in 2012

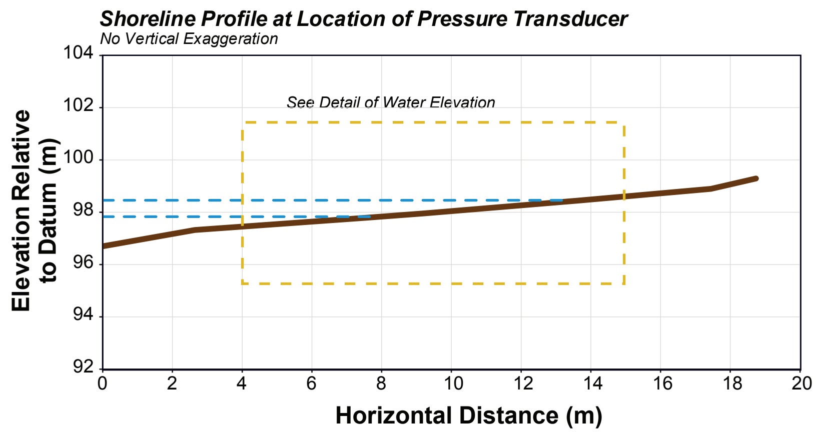
Hydrometric Station and Drainage Area	Date Measured	Pressure Transducer Stage (m)*	Measured Discharge (m^3/s)	Method (Equipment Used)
TL-2 (Doris Creek upstream location; 94.6 km^2)	June 10	99.181	2.68	Velocity-Area (FH950 current meter)
	June 13	99.220	3.94	Velocity-Area (FH950 current meter)
	July 25	98.865	0.59	Velocity-Area (Flo-Mate 2000 current meter)
	September 9	98.660	0.16	Velocity-Area (FH950 current meter)
	September 12	98.650	0.14	Velocity-Area (FH950 current meter)
TL-3 (Doris Creek downstream location; 95.3 km^2)	June 11	97.767	3.66	Velocity-Area (ADCP)
	June 14	97.794	3.77	Velocity-Area (ADCP)
	July 27	97.304	0.74	Velocity-Area (Flo-Mate 2000 current meter)
	September 10	97.119	0.27	Velocity-Area (FH950 current meter)
Roberts Hydro (97.9 km^2)	June 8	99.415	2.33	Velocity-Area (FH950 current meter)
	June 14	99.499	4.20	Velocity-Area (ADCP)
	July 26	99.159	0.51	Velocity-Area (Flo-Mate 2000 current meter)
	September 10	99.006	0.11	Velocity-Area (FH950 current meter)
Windy Hydro (14.1 km^2)	June 8	95.140	0.32	Velocity-Area (FH950 current meter)
	June 12	95.142	0.34	Velocity-Area (FH950 current meter)
	July 26	95.046	0.14	Velocity-Area (Flo-Mate 2000 current meter)
	September 11	94.966	0.06	Velocity-Area (FH950 current meter)

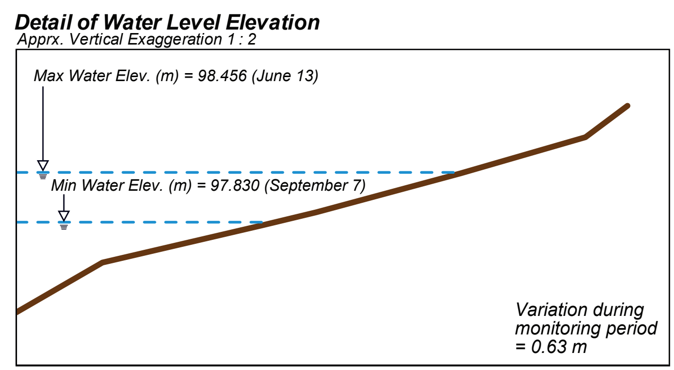
** Stage is referenced to a site specific (non-geodetic) datum.*

3.2 LAKE WATER LEVELS

Water level variation for Doris Lake during the open water season (June to September) was 0.626 m, ranging from a minimum of 97.830 m on September 7 to a maximum of 98.456 m on June 13 (Table 3.2-1). A single peak water level was measured in Doris Lake in 2012, occurring on June 13 as a result of snow and ice melt during freshet. After the freshet peak, lake water levels declined steadily at a rate of approximately 0.007 m/day, with the exception of a slight, temporary increase in response to a rainfall event (12.95 mm) that occurred on July 22. Mean daily water levels for Doris Lake are presented in Figure 3.2-1 and in tabular form in Appendix B-1.







Note: Water levels are referenced to a site specific non-geodetic datum

Figure 3.2-1

NEWMONT NORTH AMERICA

Water Levels at Doris Lake, June to September 2012

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Table 3.2-1. Lake Water Level Variations at the Doris North Project in 2012

Lake	Min Water Level (m)	Max Water Level (m)	Water Level Change (m)	Lake Area (km^2)	Drainage Area (km^2)
Doris	97.830	98.456	0.626	3.4	94.6
Tail	93.986	94.482	0.495	0.8	4.2
Windy	94.963	95.143	0.180	5.3	14.1

The partial construction of the North Dam blocked the natural outflow from Tail Lake. As a result, the water level fluctuations in Tail Lake are affected by the pumping of water from the lake into Doris Creek. At Tail Lake, water level during the open water season ranged from 93.986 m on September 12 to 94.482 m on June 12, for a total variation of 0.495 m (Table 3.2-1). A single peak water level was recorded on June 12 during freshet. After that date, water level declined at an approximate rate of 0.008 m/day until late July, when several rain events caused a slight increase. Water level continued to decline until late August, when rainfall caused another increase. The magnitude of rainfall-induced recharge may have been offset by pumping from Tail Lake, which commenced on June 11 and continued until the Doris TL-2 hydrometric station was demobilized on September 13. Mean daily water levels for Tail Lake are presented in Figure 3.2-2 and in tabular form in Appendix B-2.

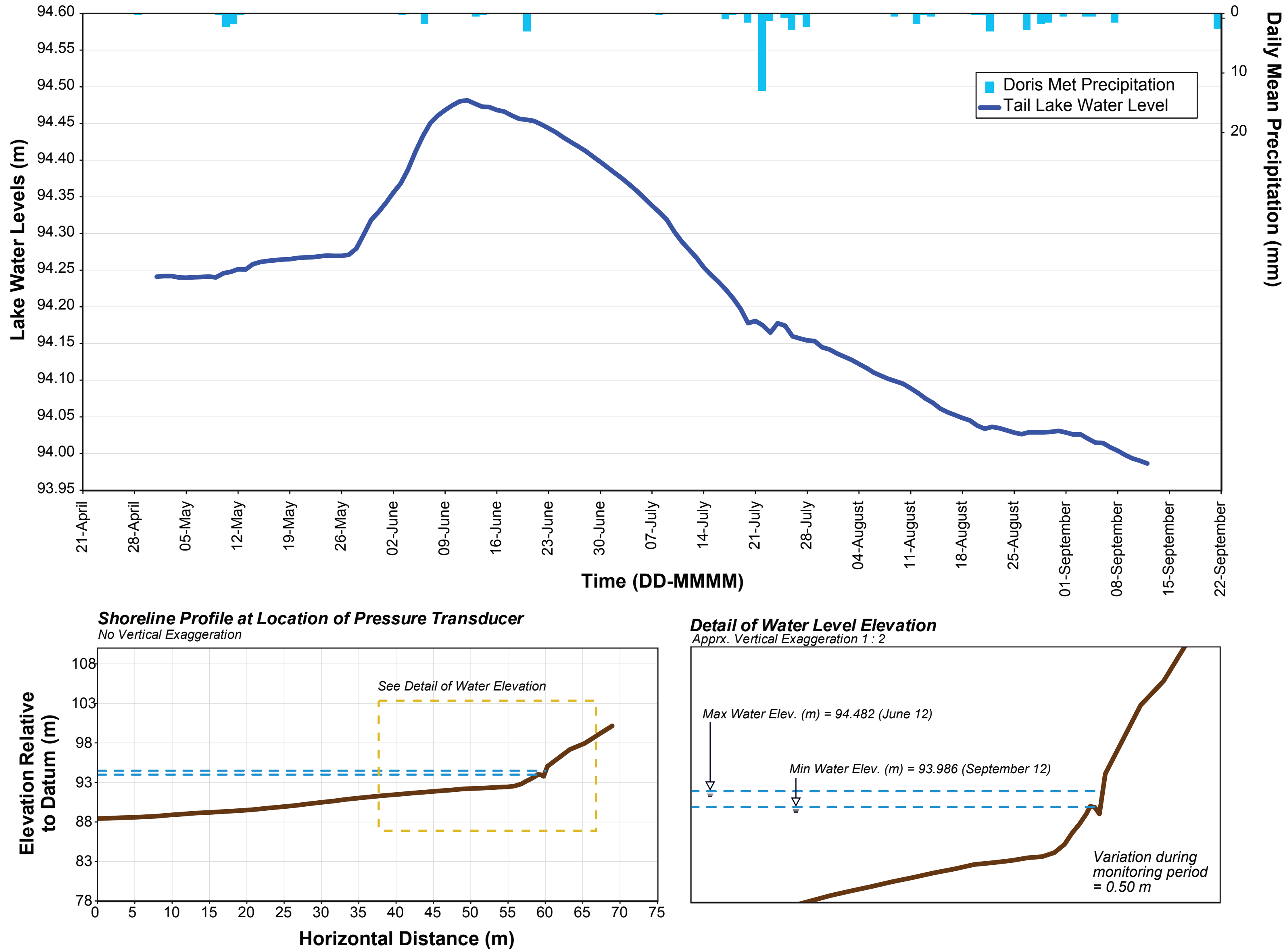
At Windy Lake, water level variation over the open water season was 0.18 m, less than that observed at Doris and Tail Lakes (Table 3.2-1). Water level increased rapidly from June 6 (the date of station remobilization) to June 9, then remained elevated during the rest of June, reaching a peak of 95.143 m on June 23. After freshet, water level in Windy Lake declined at an approximate rate of 0.003 m/day until late August, when recharge occurred briefly as a result of late summer and early fall rain events. Water level continued to decline in early September. The lowest level recorded for 2012 was 94.963 m on September 12, immediately before the station was demobilized for winter. Mean daily water levels for Windy Lake are presented in Figure 3.2-3 and in tabular form in Appendix B-3.

3.3 ROBERTS BAY WATER LEVELS

The data recorded by the tidal gauge at Roberts Bay reflect both tidal and non-tidal signals driving changes in water level. In addition to changes in tide height, water levels in Roberts Bay are affected by waves, wind, and freshwater runoff contributions. Tides with one cycle (one high and one low) per lunar day (24 hours, 50 minutes) are diurnal and tides with two cycles per lunar day are semi-diurnal. The results from Roberts Bay (Figure 3.3-1) show that the tides in Roberts Bay are predominantly semi-diurnal. A diurnal tide frequency also occurs every two weeks preceding the spring tides of the new and full moons. Hence, the tides in Roberts Bay are classified as mixed tides.

To provide an indication of the relative impact of tidal and non-tidal effects on water levels in Roberts Bay, tidal effects were extracted using classical harmonic analysis (Pawlowicz et al. 2002). The results show that the increasing trend of water levels from July to September 2012 is driven by non-tidal effects, potentially as a result of freshwater runoff into the bay (Figure 3.3-1).

The tides in Roberts Bay are microtidal (less than 2 m tide range). Daily water levels (based on a lunar day of 24 hours and 50 minutes) generally ranged from 0.2 m to 0.3 m (average: 0.26 ± 0.06 m), with a maximum tidal range (the difference between high and low water in one tidal cycle) of 0.51 m on August 1, 2012 during the spring tide.



Note: Water levels are referenced to a site specific non-geodetic datum

Figure 3.2-2

NEWMONT NORTH AMERICA

Water Levels at Tail Lake, May to September 2012

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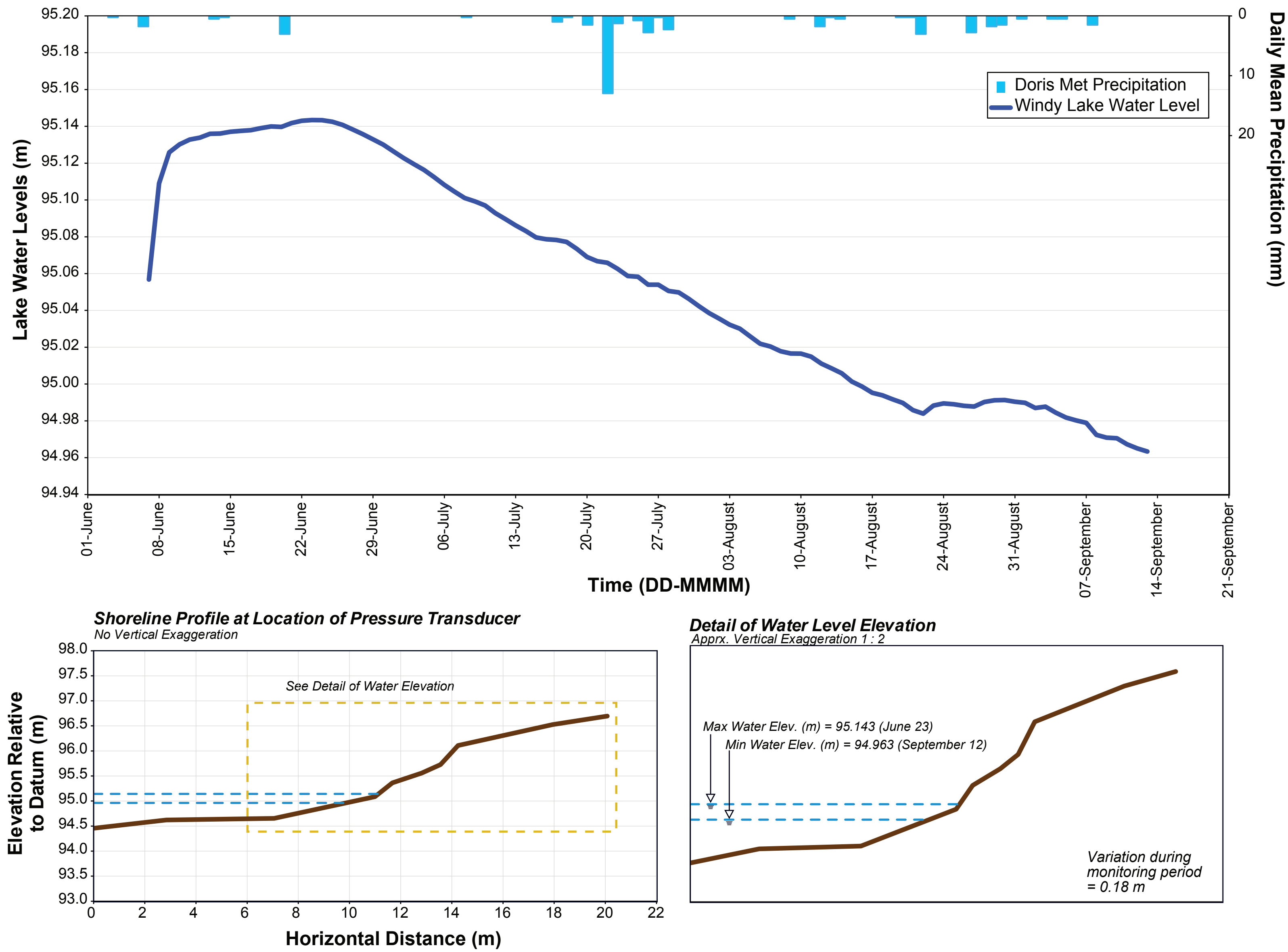

Note: Water levels are referenced to a site specific non-geodetic datum

Figure 3.2-3

NEWMONT NORTH AMERICA

Water Levels at Windy Lake, June to September 2012

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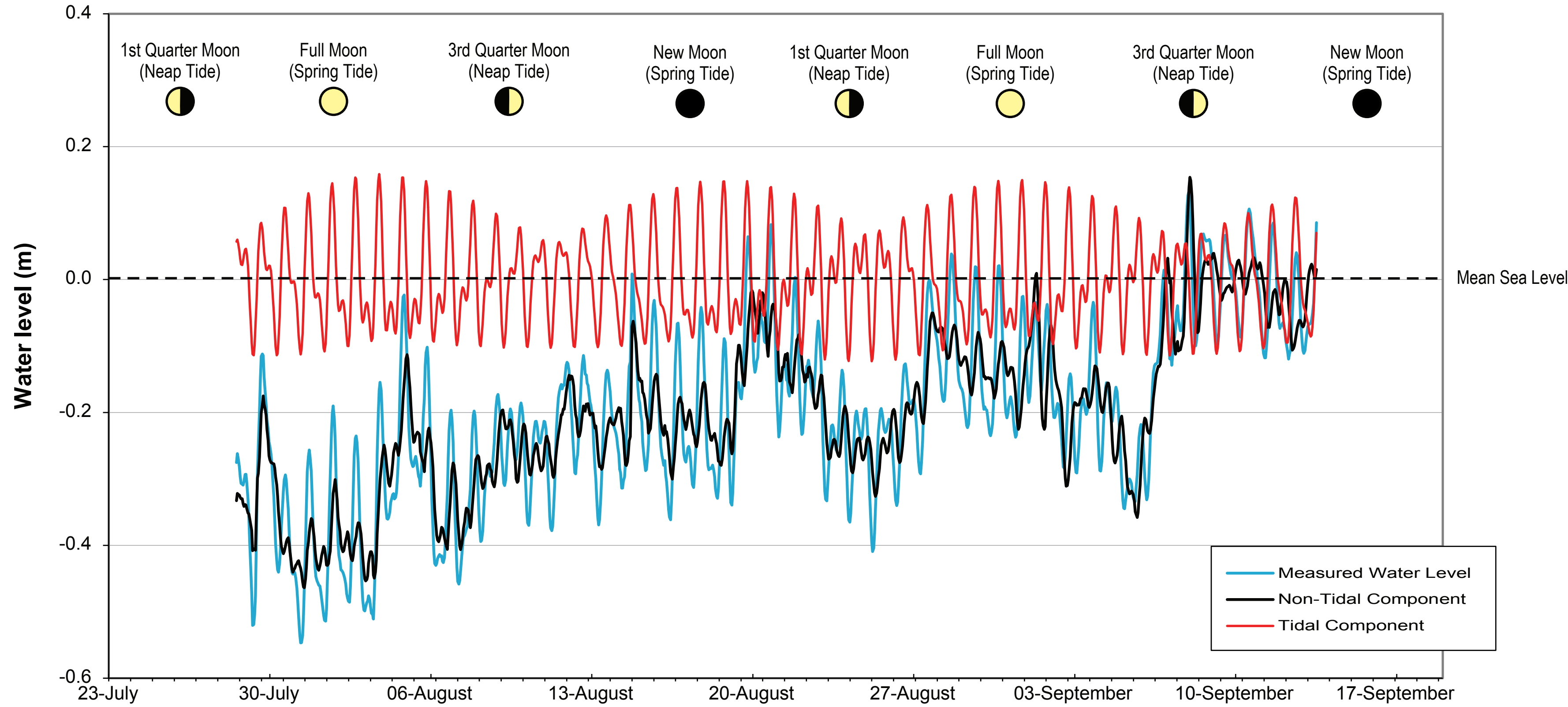

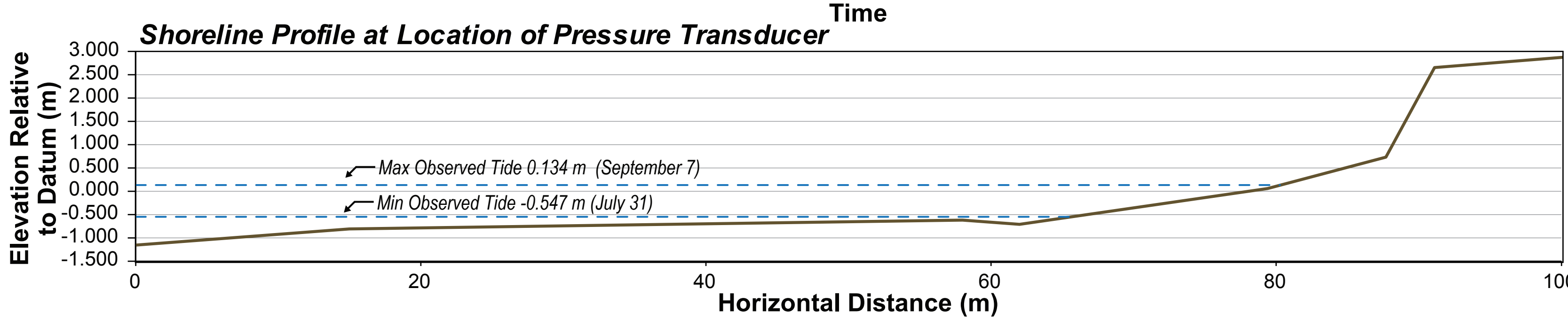

Note: Sea levels are referenced to a geodetic datum (elevation 2.945 m asl)

NEWMONT NORTH AMERICA

Water Level Fluctuation at Roberts Bay, July to September 2012

Figure 3.3-1

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3.4 STAGE-DISCHARGE RELATIONSHIPS

At the four hydrometric stream monitoring stations (Doris TL-2, Doris TL-3, Roberts Hydro, and Windy Hydro) discharge measurements obtained during 2012 were used to update existing stage-discharge relationships.

At stations TL-2 and TL-3 the developed stage-discharge relationships changed between low, mid, and high stage conditions. At the Windy Hydro station, the developed stage-discharge relationship changed between low and high stage conditions. As a result, a separate stage-discharge rating equation was developed for each stage condition for these stations. A two-stage rating curve (i.e., low and high stage) is typically developed when the hydraulic conditions at a site change from section control to channel control. Section control occurs when water flows are well-confined within the channel, whereas channel control occurs when the stream overflows its banks during high flow conditions. In the case of stations TL-2 and TL-3, a three-stage rating curve (i.e., low, mid, and high stage) was applied because both locations are characterized by a steep right bank that confines the flow and a gradually sloping left bank with a steeper 'step' at the top of the floodplain (channel cross-sections for TL-2 and TL-3 are provided in Appendix C-1 and Appendix C-2, respectively). As with a typical two-stage rating relationship, flows at TL-2 and TL-3 are confined by the channel at low stages (section control), but two channel controls apply at higher stages – the first when the stream overflows its banks, and the second when it reaches the 'step' on the floodplain. At station TL-2, a large mat of grass and aquatic vegetation grows on the left bank during the summer months (Plate 3.4-1). During moderately high flow conditions, this vegetation artificially elevates the stage readings (i.e., it produces increased water levels that not correlated with higher discharge). To compensate for this effect, a shift was added to the rating curve, applying only to mid flows during the summer months.

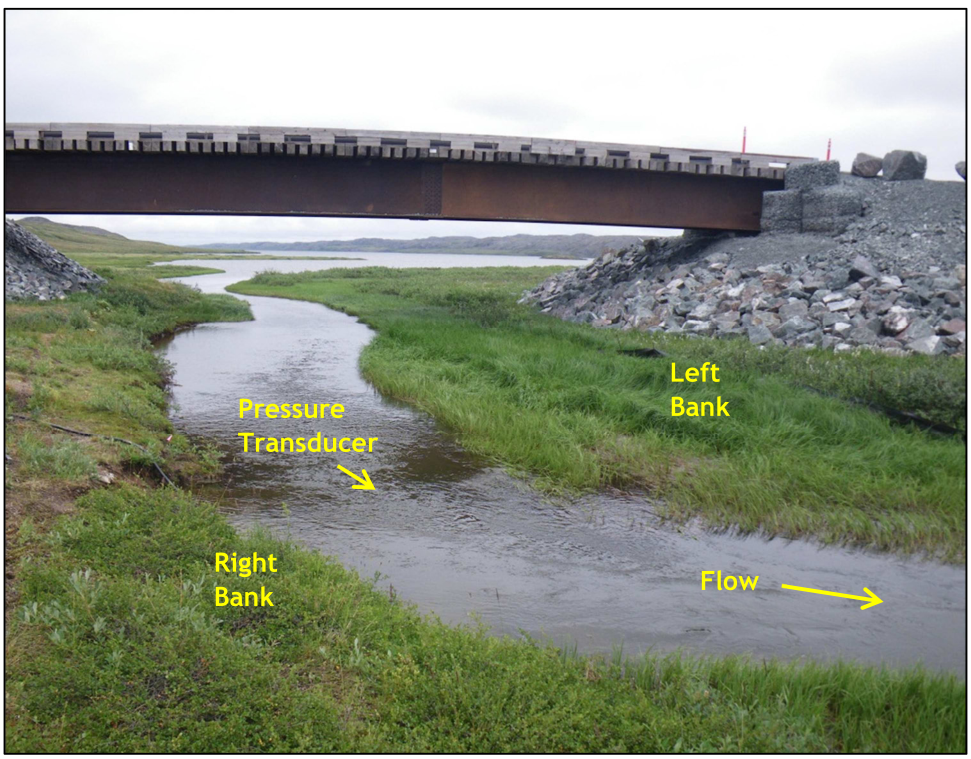

Plate 3.4-1. Doris TL-2 hydrometric monitoring station. View is upstream (south) towards Doris Lake. Thick vegetation is present along the left bank (right side of image). July 25, 2012.

The Aquarius® software used for developing the rating curves uses Root Mean Square (RMS) as an overall measure of error of the stage-discharge relation. RMS is a statistical parameter that describes how well the values predicted by the stage-discharge relation fit or represent the observed data. The departure from true values computed by this statistic combines both bias and lack of precision. The lower the RMS, the better the estimated values provided by the rating relationship. Rating equations for all sites are summarized in Table 3.4-1 and rating curves for the hydrometric stations are provided in Appendix C.

Table 3.4-1. Summary of 2012 Rating Equations for Hydrometric Stream Monitoring Stations at the Doris North Project

Hydrometric Station	Rating Equation $Q = C\ (h-a)^B$	Root Mean Square
TL-2 (Doris upstream)		
low stage	$Q = 11.851\ (h-98.482)^{2.489}$	10.7
mid stage	$Q = 4.608\ (h-98.453)^{2.013}$	10.7
high stage	$Q = 9.028\ (h-98.638)^{1.742}$	10.7
TL-3 (Doris downstream)		
low stage	$Q = 5.778\ (h-96.910)^{1.958}$	2.4
mid stage	$Q = 1.569\ (h-96.663)^{1.747}$	2.4
high stage	$Q = 8.218\ (h-97.121)^{1.994}$	2.4
Roberts Hydro		
all stages	$Q = 10.370\ (h-98.870)^{2.301}$	19.7
Windy Hydro		
low stage	$Q = 3.533\ (h-94.835)^{2.011}$	27.4
high stage	$Q = 6.134\ (h-94.892)^{2.007}$	27.4

Q = discharge [m^3/s]; C = y intercept; h = recorded stage [m]; a = stage at zero flow (datum correction) [m]; ^{B} = slope

3.5 HYDROGRAPHS

Discharge hydrographs for 2012 were generated for the hydrometric stations Doris TL-2, Doris TL-3, Roberts Hydro, and Windy Hydro. The hydrographs are presented as mean daily discharge (m^3/s) in graphic form in Figures 3.5-1 to 3.5-4 and in tabular form in Appendix E.

The onset of the spring freshet occurred in early June. Water levels in the monitored streams reached an annual peak in mid- to late-June as a result of melting of ice and snow associated with freshet conditions. Discharges at Doris TL-2, Doris TL-3, and Roberts Hydro declined steadily after freshet. Discharge at Windy Hydro declined until mid-July, when it underwent a slight, temporary increase in response to several rain events. During a dry period in late July and early August, discharge at Windy Hydro continued to decrease until August 22 - 28, when it again temporarily increased in response to several days of rainfall. After the rainy period in late August, discharge continued to decrease.

3.6 HYDROLOGICAL INDICES

3.6.1 Calculated Runoff and Mean Flow

The calculated runoff and mean flow for station Doris TL-2 for the period of record in 2012 were 104 mm and 1.16 m^3/s, respectively (Table 3.6-1). Comparatively, 2012 was a drier year than 2011 in terms of runoff and mean flow. In 2011, the calculated runoff at TL-2 totaled 184 mm, and the mean flow for the period of record was 1.58 m^3/s (Rescan 2011b). Runoff and mean flow values at TL-2 for 2012 were similar to those in 2010, when calculated runoff totaled 121 mm and the mean flow for the period of record was 1.15 m^3/s (Rescan 2011a).

PROJECT # 1009-008-04 ILLUSTRATION # a39296n December 6, 2012

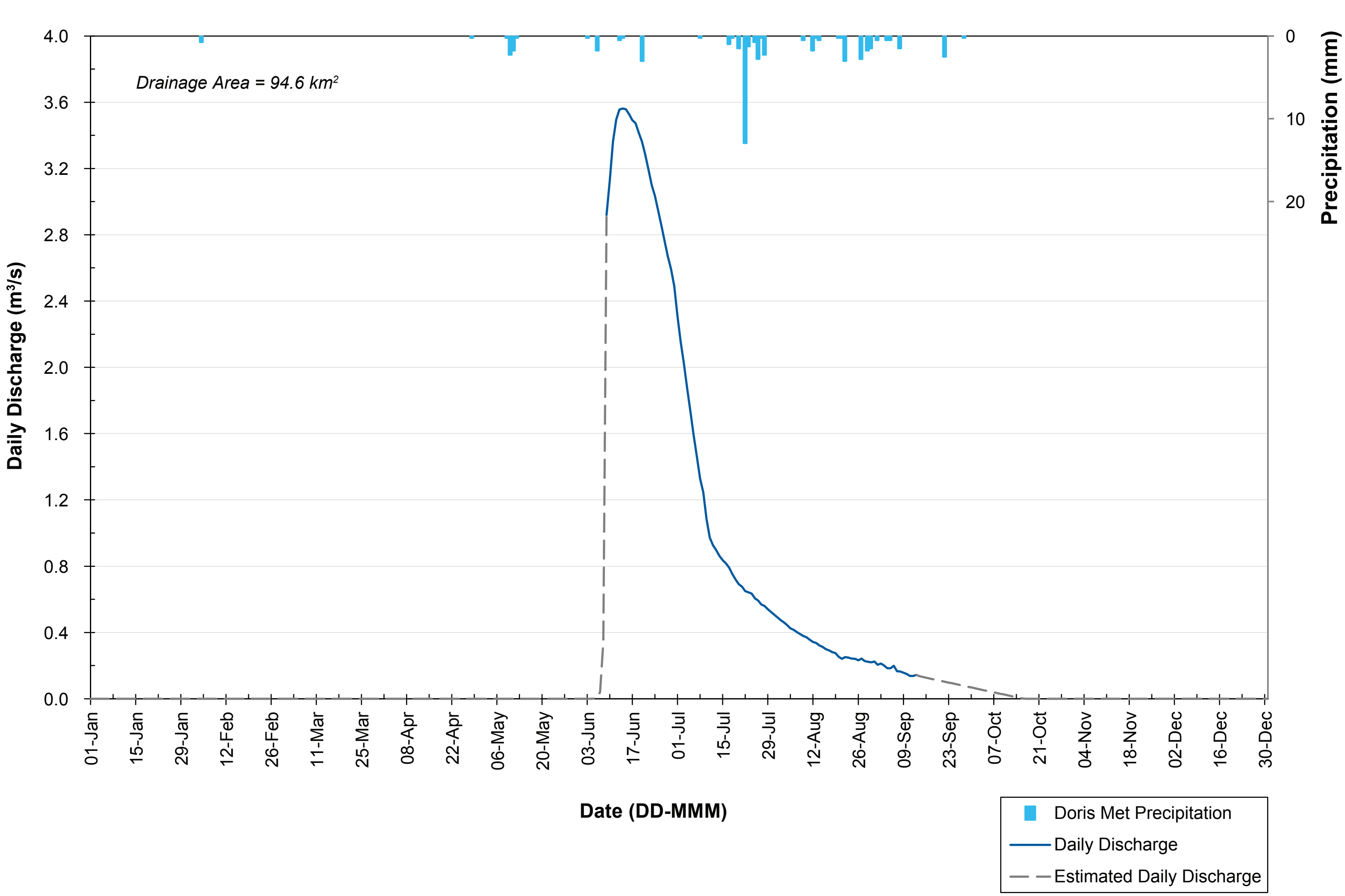

Figure 3.5-1

Annual Hydrograph at Doris TL-2 Hydrometric Monitoring Station, 2012

NEWMONT NORTH AMERICA

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Figure 3.5-1

PROJECT # 1009-008-04 ILLUSTRATION # a39297n December 6, 2012

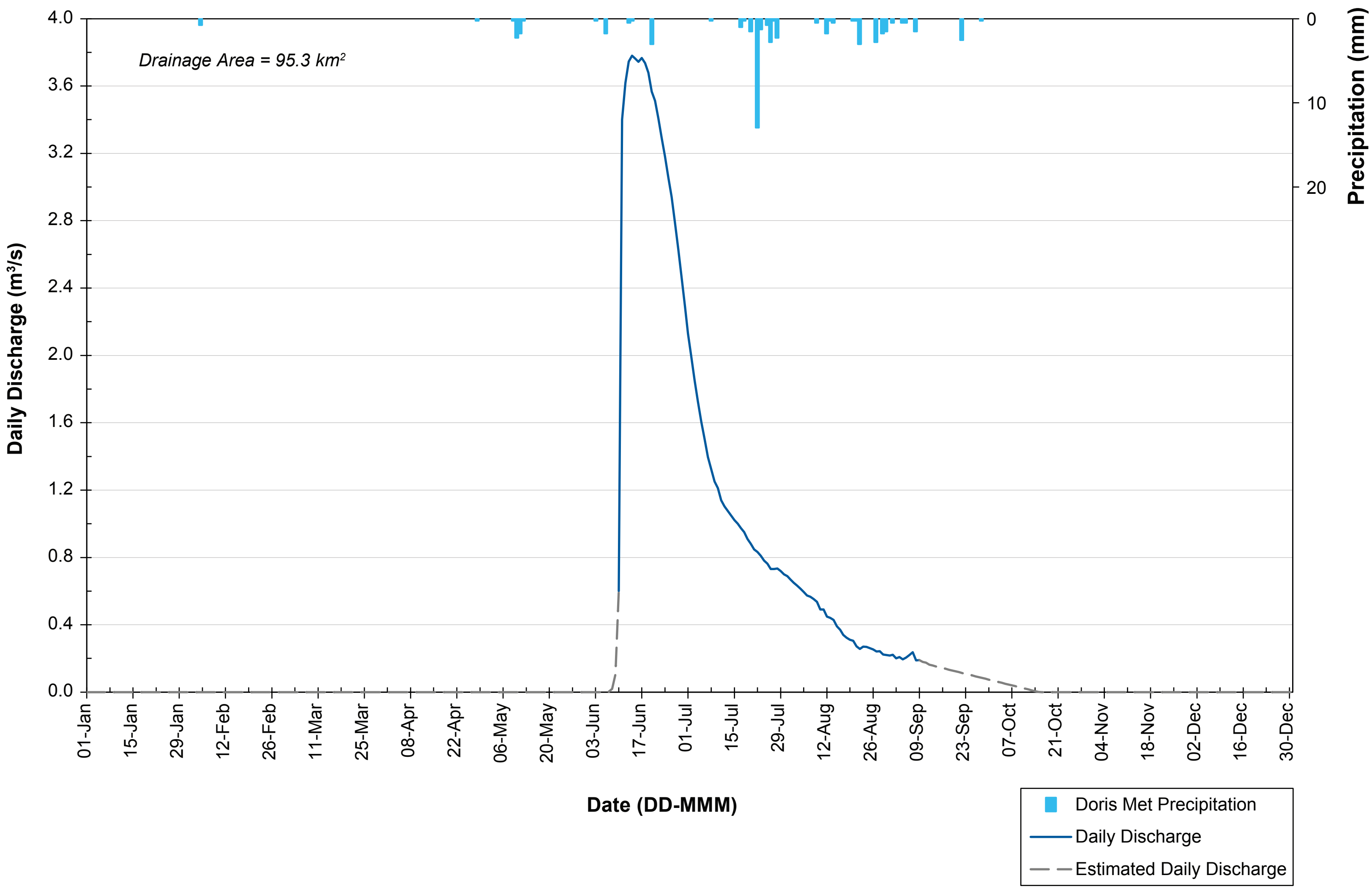

Figure 3.5-2

Annual Hydrograph at Doris TL-3 Hydrometric Monitoring Station, 2012

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Figure 3.5-2

PROJECT # 1009-008-04 ILLUSTRATION # a39298n December 6, 2012

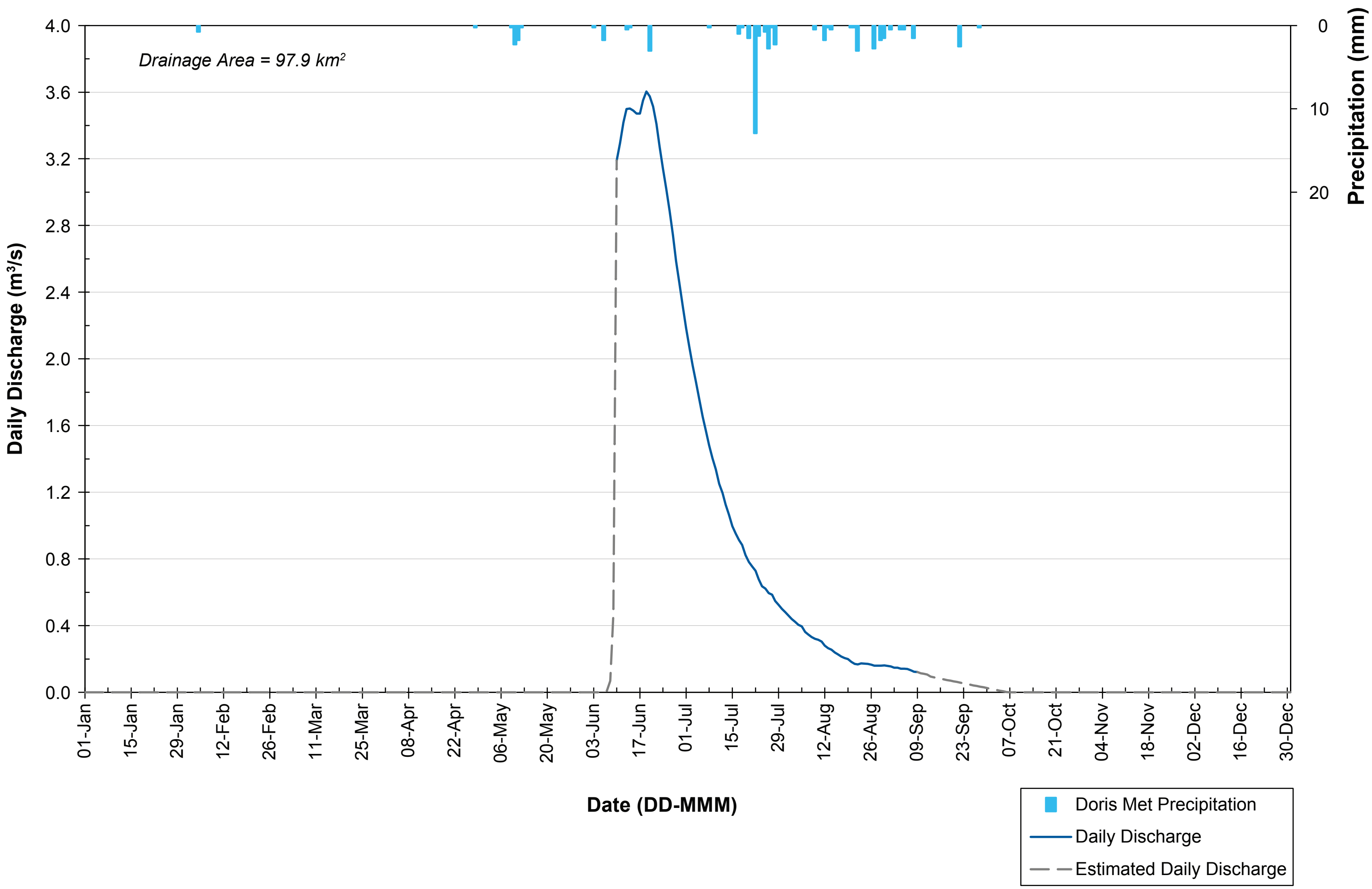


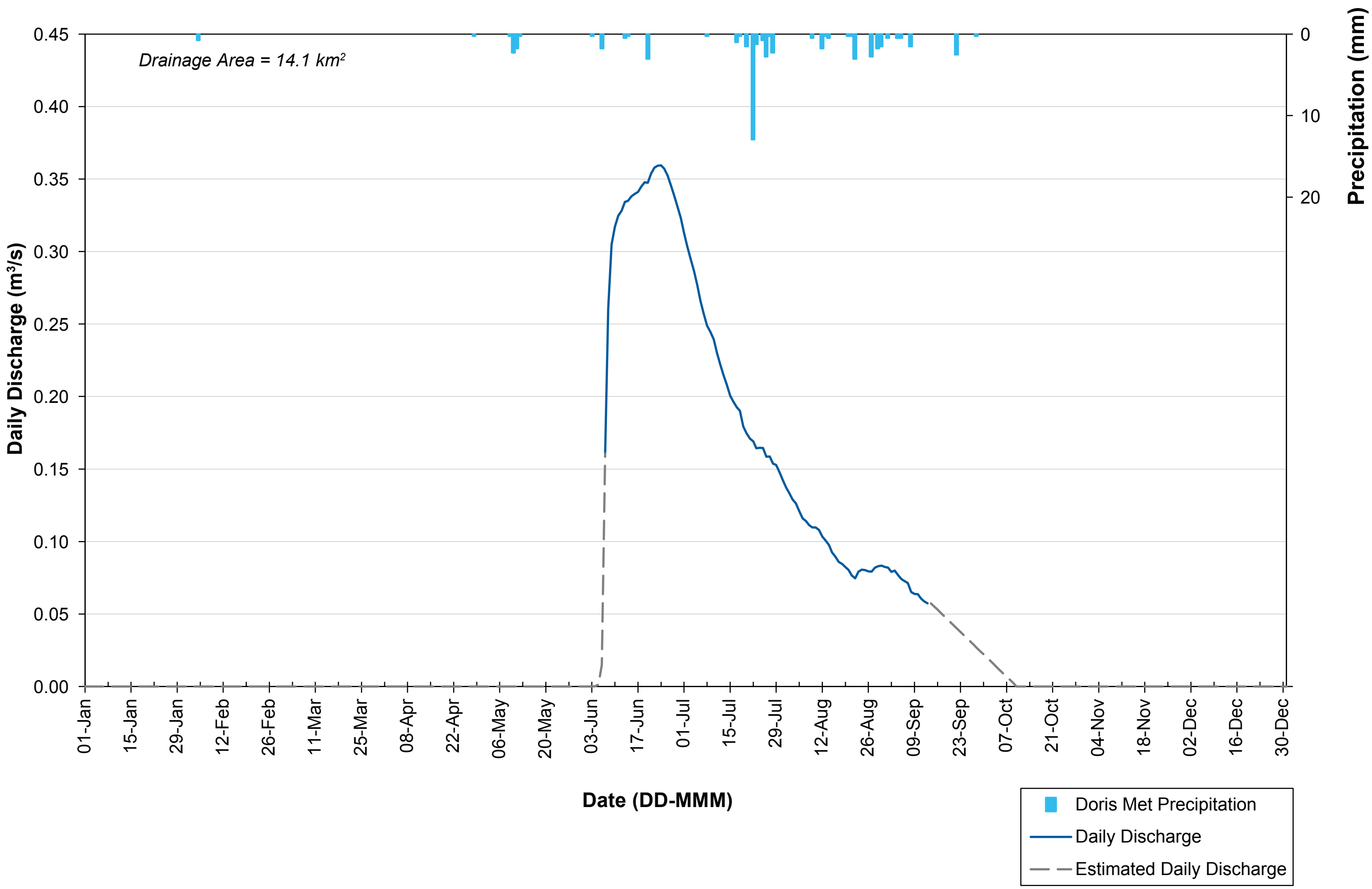
Figure 3.5-3

NEWMONT NORTH AMERICA

Annual Hydrograph at Roberts Hydro Hydrometric Monitoring Station, 2012

Figure 3.5-3

Rescan Engineers & Scientists



NEWMONT NORTH AMERICA

Annual Hydrograph at Windy Hydro Hydrometric Monitoring Station, 2012

Figure 3.5-4

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Table 3.6-1. 2010 - 2012 Annual Runoff at Compliance Hydrometric Monitoring Stations in the Doris North Project Area

Hydrometric Station Name	Watershed Area (km^2)	Calculated Runoff for Period of Record (mm)			Mean Flow for Period of Record (m^3/s)		
		2010	2011	2012	2010	2011	2012
Doris TL-2	94.6	121 (10 Jun to 4 Oct)	184 (12 Jun to 17 Oct)	104 (9 Jun to 13 Sep)	1.15	1.58	1.16
Doris TL-3	95.3	*n/a*	183 (12 Jun to 17 Oct)	105 (10 Jun to 10 Sep)	*n/a*	1.58	1.23
Roberts Hydro	97.8	137 (14 Jun to 2 Oct)	144 (21 Jun to 25 Sep)	98 (7 Jun to 11 Sep)	1.40	1.68	1.16
Windy Hydro	14.1	197 (10 Jun to 24 Sep)	143 (22 Jun to 23 Sep)	112 (6 Jun to 12 Sep)	0.30	0.26	0.22

n/a - not applicable; station was not in operation during 2010

Station Doris TL-3, which is located approximately 500 m downstream of station Doris TL-2, had slightly higher runoff and mean flow in comparison. Calculated runoff and mean flow at TL-3 for the 2012 period of record were 105 mm and 1.23 m^3/s, respectively (Table 3.6-1). These values were lower than in 2011, when calculated runoff was 183 mm and mean flow was 1.58 m^3/s (Rescan 2011b). The station was a new addition to the monitoring network in 2011, so results for 2010 are not available.

The calculated runoff and mean flow for the Roberts Hydro station for the 2012 period of record were 98 mm and 1.16 m^3/s, respectively (Table 3.6-1). Runoff and mean flow at Roberts Hydro were lower in 2012 than in 2011 and 2010. In 2011, calculated runoff was 144 mm and the mean flow for the period of record was 1.68 m^3/s (Rescan 2011b). In 2010, calculated runoff was 137 mm and mean flow for the period of record was 1.40 m^3/s (Rescan 2011a).

At station Windy Hydro, calculated runoff and mean flow for the period of record in 2012 were 112 mm and 0.22 m^3/s, respectively (Table 3.6-1). These values were substantially lower than in 2011 and 2010. In 2011, calculated runoff was 143 mm and mean flow for the period of record was 0.26 m^3/s (Rescan 2011b). In 2010, calculated runoff was 197 mm and peak flow was 0.30 m^3/s (Rescan 2011a).

3.6.2 Peak and Low Flows

The calculated instantaneous peak flow for station Doris TL-2 was 3.62 m^3/s on June 14 (Table 3.6-2). The daily peak flow of 3.56 m^3/s also occurred on June 14. The corresponding instantaneous peak unit yield was 38.29 $L/s/km^2$, and the daily peak unit yield was 37.65 $L/s/km^2$. In 2012, the observed peak flows and unit yields were approximately 38% lower than peaks observed in 2011, and approximately 21% lower than the peaks observed in 2010 (Table 3.6-2, Rescan 2011a, b).

Instantaneous peak flow and calculated daily peak flow for station Doris TL-3 were 3.83 m^3/s and 3.78 m^3/s, respectively, on June 14 (Table 3.6-2). Instantaneous peak unit yield was 40.14 $L/s/km^2$, and daily peak unit yield was 39.66 $L/s/km^2$. Peak flows and unit yields for 2012 were approximately 35% lower than 2011 (Table 3.6-2, Rescan 2011b). Station TL-3 was installed in 2011, so results prior to 2011 are not available.

At station Roberts Hydro, instantaneous peak flow in 2012 was 3.63 m^3/s and calculated daily peak flow was 3.60 m^3/s on June 18 (Table 3.6-2). Instantaneous peak unit yield was 37.09 $L/s/km^2$, and daily peak unit yield was 36.82 $L/s/km^2$. Peak values observed in 2012 were approximately 51% lower than the peaks observed in 2011, and approximately 38% lower than the peaks observed in 2010 (Table 3.6-2, Rescan 2011a, b).Calculated instantaneous (0.37 m^3/s) and daily (0.36 m^3/s) peak flow for station Windy Hydro occurred on June 23 (Table 3.6-2). Instantaneous peak unit yield and daily peak unit yield were 25.93 $L/s/km^2$ and 25.49 $L/s/km^2$, respectively. Peak flow and unit yield values at Windy Hydro for the 2012 period of record were approximately 44% lower than peaks for 2011, and approximately 25% lower than peaks for 2010 (Table 3.6-2, Rescan 2011a, b).

Table 3.6-2. 2010 - 2012 Peak Flow, Peak Unit Yield, and Time of Occurrence at Compliance Hydrometric Monitoring Stations in the Doris North Project Area

Hydrometric Station Name	Year	Peak Flow(m^3/s)		Date of Instantaneous Peak	Peak Unit Yield ($L/s/km^2$)	
		Instantaneous	Daily		Instantaneous	Daily
Doris TL-2	2010	4.61	4.42	19 June	48.57	46.73
	2011	5.88	5.77	5 July	62.19	60.90
	2012	3.62	3.56	14 June	38.29	37.65
Doris TL-3	2011	5.96*	5.86	5 July	62.51*	61.50*
	2012	3.83	3.78	14 June	40.14	39.66
Roberts Hydro	2010	5.84	5.78	17 June	59.59	58.97
	2011	7.47	7.34	3 July	76.35	75.00
	2012	3.63	3.60	18 June	37.09	36.82
Windy Hydro	2010	0.49	0.46	23 July	34.95	32.55
	2011	0.66	0.64	5 July	46.62	45.47
	2012	0.37	0.36	23 June	25.93	25.49

**Estimated value*

The observed low flows for the 2012 period of record at all hydrometric stream monitoring stations occurred in early September, immediately prior to station demobilization for winter. Low flows in 2012 were substantially lower than 2010 and 2011 for all stations, generally ranging from approximately 45-70% less than low flows in 2010 and 2011 (Rescan 2011a, b).

At station Doris TL-2, the low flow of 0.138 m^3/s on September 11 was less than half the magnitude of low flows observed in 2010 and 2011 (Table 3.6-3). Similarly, the recorded low flow at station Doris TL-3 (0.174 m^3/s on September 11) was less than half of the 2011 recorded low flow (0.365 m^3/s).

At station Roberts Hydro, the observed low flow in 2012 was 0.107 m^3/s on September 12 (Table 3.6-3). This value is similar to the low flow observed in 2011 (0.116 m^3/s), but both 2011 and 2012 low flows at Roberts Hydro were less than the 2010 low flow of 0.327 m^3/s.

The observed low flow in 2012 at station Windy Hydro was 0.057 m^3/s on September 13 (Table 3.6-3). This was approximately half the magnitude of the observed low flow at Windy Hydro in 2010 (0.159 m^3/s) and less than half of the magnitude of the observed low flow in 2011 (0.105 m^3/s).

Table 3.6-3. 2010 - 2012 Daily Low Flows at Compliance Hydrometric Monitoring Stations in the Doris North Project Area

Hydrometric Station Name	Year	Daily Low Flow (m^3/s)	Date
Doris TL-2	2010	0.450	September 29
	2011	0.400	September 6
	2012	0.138	September 11
Doris TL-3	2011	0.365	September 6
	2012	0.174	September 11
Roberts Hydro	2010	0.327	September 3
	2011	0.116	September 3
	2012	0.107	September 12
Windy Hydro	2010	0.159	September 24
	2011	0.105	September 23
	2012	0.057	September 13

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Appendix A

2012 Manual Discharge Measurements at Hydrometric Monitoring Stations in the Doris North Project Area

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Appendix A-1. Manual Flow Measurements at Doris-Hydro TL-2 in 2012

Date Monitored: 10-Jun-12 **Discharge:** 2.68 m^3/s
Start Time (24 hr): 8:20
End Time (24 hr): 9:00
Personnel: Craig Hatt and Leonard Wingnek
Method: Velocity-Area
Instrument: Hach FH950 with top setting rod
Stage: 99.181

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	Total Q
Right bank	2.00	0.00	0.00	0.020	0.00			0.00	0.0
	2.30	0.13	0.30	0.05	0.04			0.00	0.1
	2.80	0.24	0.50	0.12	0.01			0.00	0.0
	3.30	0.19	0.50	0.10	0.09			0.01	0.3
	3.80	0.26	0.50	0.13	0.09			0.01	0.4
	4.30	0.30	0.50	0.15	0.05			0.01	0.3
	4.80	0.32	0.50	0.13	0.13			0.02	0.6
Open water	5.10	0.36	0.30	0.11	0.16			0.02	0.6
	5.40	0.33	0.30	0.10	0.24			0.02	0.9
	5.70	0.40	0.30	0.10	0.54			0.05	2.0
	5.90	0.53	0.20	0.13	0.80			0.11	3.9
	6.20	0.55	0.30	0.17	0.89			0.15	5.5
	6.50	0.56	0.30	0.17	0.99			0.17	6.2
	6.80	0.58	0.30	0.17	1.06			0.18	6.9
	7.10	0.59	0.30	0.18	1.11			0.20	7.3
	7.40	0.58	0.30	0.17	1.20			0.21	7.8
	7.70	0.58	0.30	0.17	1.16			0.20	7.5
	8.00	0.58	0.30	0.17	1.02			0.18	6.7
	8.30	0.57	0.30	0.17	1.17			0.20	7.5
	8.60	0.56	0.30	0.17	1.10			0.19	6.9
	8.90	0.58	0.30	0.17	1.10			0.19	7.2
	9.20	0.54	0.30	0.16	1.15			0.19	7.0
	9.50	0.50	0.30	0.15	0.73			0.11	4.1
	9.80	0.45	0.30	0.14	0.59			0.08	3.0
	10.10	0.40	0.30	0.12	0.70			0.08	3.1
	10.40	0.40	0.30	0.12	0.52			0.06	2.3
	10.70	0.39	0.30	0.12	0.04			0.00	0.2
	11.00	0.40	0.30	0.16	0.09			0.01	0.5
	11.50	0.30	0.50	0.20	0.13			0.03	1.0
	12.30	0.16	0.80	0.12	0.01			0.00	0.1
Left bank	13.00	0.00	0.70	0.06	0.00			0.00	0.0
Total Q								**2.68**	100.0

Appendix A-1. Manual Flow Measurements at Doris-Hydro TL-2 in 2012

Date Monitored: 13-Jun-12 **Discharge:** 3.94 m^3/s
Start Time (24 hr): 7:30
End Time (24 hr): 8:30
Personnel: Craig Hatt and Leonard Wingnek
Method: Velocity-Area
Instrument: Hach FH950 with top setting rod
Stage: 99.220

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**Total Q**
Right bank	1.30	0.00	0.00	0.033	0.00			0.00	0.0
	1.90	0.11	0.60	0.05	0.00			0.00	0.0
	2.20	0.19	0.30	0.12	0.00			0.00	0.0
	3.20	0.18	1.00	0.18	0.04			0.01	0.2
	4.20	0.25	1.00	0.25	0.05			0.01	0.3
	5.20	0.38	1.00	0.34	0.09			0.03	0.8
	6.00	0.33	0.80	0.18	0.15			0.03	0.7
	6.30	0.31	0.30	0.09	0.15			0.01	0.3
	6.55	0.51	0.25	0.11	0.71			0.08	2.1
	6.75	0.54	0.20	0.11	0.79			0.09	2.2
	6.95	0.52	0.20	0.10	0.88			0.09	2.3
	7.15	0.56	0.20	0.11	0.99			0.11	2.8
	7.35	0.62	0.20	0.12	1.03			0.13	3.2
	7.55	0.66	0.20	0.13	1.05			0.14	3.5
	7.75	0.69	0.20	0.14	1.07			0.15	3.8
	7.95	0.69	0.20	0.14	1.11			0.15	3.9
	8.15	0.68	0.20	0.14	1.17			0.16	4.0
	8.35	0.69	0.20	0.14	1.24			0.17	4.4
	8.55	0.67	0.20	0.13	1.20			0.16	4.1
	8.75	0.66	0.20	0.13	1.15			0.15	3.8
	8.95	0.64	0.20	0.13	1.11			0.14	3.6
	9.15	0.54	0.20	0.11	1.26			0.14	3.5
	9.35	0.57	0.20	0.11	1.25			0.14	3.6
	9.55	0.59	0.20	0.12	1.16			0.14	3.5
	9.75	0.56	0.20	0.11	1.14			0.13	3.2
	9.95	0.54	0.20	0.11	1.24			0.13	3.4
	10.15	0.57	0.20	0.11	1.18			0.13	3.4
	10.35	0.59	0.20	0.12	1.14			0.13	3.4
	10.55	0.50	0.20	0.10	0.61			0.06	1.5
	10.75	0.47	0.20	0.11	0.72			0.08	1.9
	11.00	0.47	0.25	0.12	0.73			0.09	2.2
	11.25	0.42	0.25	0.11	0.81			0.08	2.1
	11.50	0.39	0.25	0.10	0.49			0.05	1.2
	11.75	0.38	0.25	2.19	0.32			0.70	17.7
	12.00	0.43	0.25	0.22	0.14			0.03	0.7
	12.75	0.36	0.75	2.16	0.05			0.10	2.6
	13.40	0.16	0.65	0.08	0.05			0.00	0.1
Left bank	13.75	0.00	0.35	0.00	0.00			0.00	0.0
Total Q								**3.94**	100.0

Appendix A-1. Manual Flow Measurements at Doris-Hydro TL-2 in 2012

Date Monitored: 25-Jul-12 **Discharge:** 0.59 m^3/s
Start Time (24 hr): 12:10
End Time (24 hr): 12:50
Personnel: Natasha Cowie and Noah Aklah
Method: Velocity-Area
Instrument: Flow Mate 2000 with top setting rod
Stage: 98.865

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**Total Q**
Right bank	5.90	0.00	0.00	0.000	0.00			0.00	0.0
	5.75	0.19	0.15	0.03	0.55			0.02	2.6
	5.60	0.22	0.15	0.03	0.60			0.02	3.3
	5.45	0.18	0.15	0.03	0.77			0.02	3.5
	5.30	0.26	0.15	0.04	0.68			0.03	4.5
	5.15	0.26	0.15	0.04	0.83			0.03	5.5
	5.00	0.32	0.15	0.05	0.47			0.02	3.8
	4.85	0.30	0.15	0.05	0.71			0.03	5.4
	4.70	0.30	0.15	0.05	0.84			0.04	6.4
	4.55	0.32	0.15	0.05	0.72			0.03	5.8
	4.40	0.30	0.15	0.05	0.70			0.03	5.3
	4.25	0.30	0.15	0.05	0.66			0.03	5.0
	4.10	0.30	0.15	0.05	0.42			0.02	3.2
	3.95	0.32	0.15	0.05	0.44			0.02	3.6
	3.80	0.30	0.15	0.05	0.71			0.03	5.4
	3.65	0.28	0.15	0.04	0.62			0.03	4.4
	3.50	0.30	0.15	0.05	0.54			0.02	4.1
	3.35	0.29	0.15	0.04	0.50			0.02	3.7
	3.20	0.29	0.15	0.04	0.46			0.02	3.4
	3.05	0.28	0.15	0.04	0.70			0.03	4.9
	2.90	0.20	0.15	0.03	0.73			0.02	3.7
	2.75	0.26	0.15	0.04	0.73			0.03	4.8
	2.60	0.26	0.15	0.04	0.59			0.02	3.9
	2.45	0.26	0.15	0.04	0.20			0.01	1.3
	2.30	0.27	0.15	0.05	0.34			0.02	2.7
Left bank	2.10	0.00	0.20	0.00	0.00			0.00	0.0
Total Q								**0.59**	100.0

Appendix A-1. Manual Flow Measurements at Doris-Hydro TL-2 in 2012

Date Monitored: 9-Sep-12 **Discharge:** 0.16 m^3/s

Start Time (24 hr): 13:30

End Time (24 hr): 14:15

Personnel: Natasha Cowie and Paulette Penton

Method: Velocity-Area

Instrument: Hach FH950 with top setting rod

Stage: 98.660

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	Total Q
Right bank	2.00	0.00	0.00	0.000	0.00			0.00	0.0
Grass upstream	2.15	0.09	0.15	0.01	0.27			0.00	2.2
	2.30	0.11	0.15	0.02	0.28			0.00	2.8
	2.45	0.12	0.15	0.02	0.21			0.00	2.3
	2.60	0.12	0.15	0.02	0.20			0.00	2.2
	2.75	0.10	0.15	0.02	0.37			0.01	3.4
	2.90	0.12	0.15	0.02	0.46			0.01	5.0
	3.05	0.16	0.15	0.02	0.54			0.01	7.8
	3.20	0.15	0.15	0.02	0.62			0.01	8.4
	3.35	0.17	0.15	0.03	0.62			0.02	9.6
	3.50	0.20	0.15	0.03	0.43			0.01	7.9
	3.65	0.18	0.15	0.03	0.32			0.01	5.2
	3.80	0.16	0.15	0.02	0.28			0.01	4.1
Rock upstream	3.95	0.14	0.15	0.02	0.27			0.01	3.4
	4.10	0.11	0.15	0.01	0.31			0.00	2.5
	4.20	0.09	0.10	0.01	0.35			0.00	2.8
	4.40	0.14	0.20	0.02	0.37			0.01	5.5
	4.55	0.15	0.15	0.02	0.34			0.01	4.7
	4.70	0.13	0.15	0.02	0.46			0.01	5.5
On rock	4.85	0.09	0.15	0.01	0.41			0.01	3.4
Grass upstream	5.00	0.10	0.15	0.02	0.23			0.00	2.1
	5.15	0.13	0.15	0.02	0.24			0.00	2.8
	5.30	0.14	0.15	0.02	0.34			0.01	4.4
	5.45	0.14	0.15	0.01	0.18			0.00	1.5
	5.50	0.15	0.05	0.01	0.08			0.00	0.5
Left bank	5.60	0.00	0.10	0.00	0.00			0.00	0.0
Total Q								**0.16**	100.0

Appendix A-1. Manual Flow Measurements at Doris-Hydro TL-2 in 2012

Date Monitored:	12-Sep-12	**Discharge:**	0.14 m^3/s
Start Time (24 hr):	16:18		
End Time (24 hr):	16:53		
Personnel:	Natasha Cowie and Leonard Wingnek		
Method:	Velocity-Area		
Instrument:	Hach FH950 with top setting rod		
Stage:	98.650		

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**Total Q**
Right bank	6.30	0.00	0.00	0.000	0.00			0.00	0.0
Grass upstream	6.15	0.06	0.15	0.01	0.03			0.00	0.2
	6.00	0.10	0.15	0.02	0.32			0.00	3.4
	5.85	0.08	0.15	0.01	0.18			0.00	1.5
	5.70	0.13	0.15	0.02	0.22			0.00	3.0
	5.55	0.09	0.15	0.01	0.24			0.00	2.3
	5.40	0.10	0.15	0.02	0.41			0.01	4.3
	5.25	0.15	0.15	0.02	0.48			0.01	7.6
	5.10	0.16	0.15	0.02	0.47			0.01	5.3
	5.05	0.18	0.05	0.01	0.59			0.01	5.7
	4.95	0.16	0.10	0.02	0.61			0.01	8.6
	4.80	0.15	0.15	0.02	0.47			0.01	7.5
	4.65	0.14	0.15	0.02	0.40			0.01	5.9
	4.50	0.13	0.15	0.02	0.26			0.00	3.5
	4.35	0.13	0.15	0.02	0.34			0.01	4.7
	4.20	0.13	0.15	0.02	0.24			0.00	3.3
Rock upstream	4.05	0.12	0.15	0.02	0.15			0.00	1.9
	3.90	0.12	0.15	0.02	0.36			0.01	4.6
	3.75	0.11	0.15	0.02	0.39			0.01	4.6
	3.60	0.13	0.15	0.03	0.35			0.01	7.2
	3.30	0.12	0.30	0.03	0.21			0.01	4.0
	3.15	0.12	0.15	0.02	0.27			0.00	3.5
	3.00	0.13	0.15	0.02	0.24			0.00	3.3
Grass upstream	2.85	0.12	0.15	0.02	0.32			0.01	4.0
Grass upstream	2.70	0.11	0.15	0.01	0.03			0.00	0.3
Left bank	2.65	0.00	0.05	0.00	0.00			0.00	0.0
Total Q								**0.14**	100.0

Appendix A-2. Manual Flow Measurements at Doris-Hydro TL-3 in 2012

Date Monitored:	11-Jun-12	**Mean Discharge Q (m^3/s):**	**3.66**
Start Time (24 hr):	9:45	**% Q Measured:**	62.9
End Time (24 hr):	10:25	**Error (StDev in m^3/s):**	0.05
Personnel:	Craig Hatt and Leonard Wingnek	**Stage:**	97.767
Method:	Velocity-Area		
Instrument:	Acoustic Doppler Current Profiler		

	Discharge Q (m^3/s)						% Q	% Bad	
Transect	**Top**	**Mid**	**Bottom**	**Left**	**Right**	**Total Q**	**Measured**	**Ens**	**Bins**
1	0.51	2.35	0.59	0.01	0.14	3.59	65.3	12.0	2.0
2	0.52	2.22	0.76	0.04	0.12	3.67	60.6	16.0	2.0
3	0.56	2.30	0.65	0.09	0.12	3.72	61.7	19.0	1.0
4	0.51	2.33	0.63	0.02	0.15	3.64	64.0	17.0	2.0
Mean	0.53	2.30	0.66	0.04	0.13	**3.66**	62.9	16.0	1.8

Date Monitored:	14-Jun-12	**Mean Discharge Q (m^3/s):**	**3.77**
Start Time (24 hr):		**% Q Measured:**	62.5
End Time (24 hr):	11:40	**Error (StDev in m^3/s):**	0.10
Personnel:	Craig Hatt and Field Assistant	**Stage:**	97.794
Method:	Velocity-Area		
Instrument:	Acoustic Doppler Current Profiler		

	Discharge Q (m^3/s)						% Q	% Bad	
Transect	**Top**	**Mid**	**Bottom**	**Left**	**Right**	**Total Q**	**Measured**	**Ens**	**Bins**
1	0.47	2.26	0.58	0.15	0.19	3.65	62.1	18.0	4.0
2	0.53	2.46	0.56	0.16	0.19	3.89	63.1	17.0	2.0
3	0.49	2.26	0.53	0.20	0.25	3.74	60.4	20.0	0.0
4	0.52	2.46	0.54	0.04	0.25	3.81	64.7	10.0	1.0
Mean	0.50	2.36	0.55	0.14	0.22	**3.77**	62.5	16.3	1.8

Appendix A-2. Manual Flow Measurements at Doris-Hydro TL-3 in 2012

Date Monitored: 21-Jul-11 **Discharge:** 0.74 m^3/s

Start Time (24 hr): 11:00

End Time (24 hr): 11:38

Personnel: Natasha Cowie and Tony Hoare

Method: Velocity-Area

Instrument: Flow Mate 2000 with top setting rod

Stage: 97.304

Notes	Station (m)	Depth (m)	Distance (m)	Area (m^2)	Velocity (m/s) 60%	20%	80%	Q (m^3/s)	% of Total Q
Right bank	1.50	0.00	0.00	0.02	0.00			0.00	0.0
	1.60	0.46	0.10	0.05	0.39			0.02	2.4
	1.70	0.48	0.10	0.05	0.46			0.02	3.0
Rock upstream	1.80	0.48	0.10	0.05	0.21			0.01	1.4
Rock upstream	1.90	0.46	0.10	0.05	0.09			0.00	0.6
Rock upstream	2.00	0.46	0.10	0.05	0.09			0.00	0.6
	2.10	0.54	0.10	0.05	0.19			0.01	1.4
	2.20	0.52	0.10	0.08	0.53			0.04	5.6
	2.40	0.62	0.20	0.09	0.48			0.04	6.1
	2.50	0.64	0.10	0.06	0.54			0.03	4.7
	2.60	0.68	0.10	0.07	0.54			0.04	5.0
	2.70	0.70	0.10	0.07	0.55			0.04	5.2
	2.80	0.70	0.10	0.11	0.53			0.06	7.6
	2.90	0.74	0.10	0.11	0.53			0.06	8.0
	3.00	0.66	0.20	0.10	0.51			0.05	6.9
	3.10	0.68	0.10	0.07	0.51			0.03	4.7
	3.20	0.70	0.10	0.11	0.51			0.05	7.3
	3.30	0.80	0.10	0.12	0.52			0.06	8.5
	3.40	0.82	0.20	0.12	0.46			0.06	7.7
	3.50	0.76	0.10	0.08	0.41			0.03	4.2
	3.60	0.72	0.10	0.07	0.27			0.02	2.6
Rock upstream	3.70	0.62	0.10	0.06	0.03			0.00	0.3
Rock upstream	3.80	0.62	0.10	0.06	0.03			0.00	0.3
	3.90	0.68	0.10	0.07	0.29			0.02	2.7
	4.00	0.66	0.10	0.07	0.39			0.03	3.5
Left bank	4.10	0.00	0.10	0.00	0.00			0.00	0.0
Total Q								**0.74**	**100.0**

Appendix A-2. Manual Flow Measurements at Doris-Hydro TL-3 in 2012

Date Monitored: 10-Sep-12 **Discharge:** 0.27 m^3/s
Start Time (24 hr): 10:27
End Time (24 hr): 11:00
Personnel: Natasha Cowie and Leonard Wingnek
Method: Velocity-Area
Instrument: Hach FH950 with top setting rod
Stage: 97.119

Notes	Station (m)	Depth (m)	Distance (m)	Area (m^2)	Velocity (m/s) 60%	20%	80%	Q (m^3/s)	% of Total Q
RB	4.30	0.00	0.00	0.01	0.00			0.00	0.0
	4.15	0.13	0.15	0.02	0.00			0.00	0.0
grass US	4.00	0.38	0.15	0.06	0.07			0.00	1.4
grass US	3.85	0.39	0.15	0.06	0.06			0.00	1.3
grass US	3.70	0.45	0.15	0.07	0.08			0.01	2.1
	3.55	0.47	0.15	0.07	0.18			0.01	4.8
	3.40	0.49	0.15	0.07	0.03			0.00	0.7
	3.25	0.50	0.15	0.08	0.19			0.01	5.2
	3.10	0.50	0.15	0.08	0.16			0.01	4.4
	2.95	0.53	0.15	0.08	0.14			0.01	4.3
	2.80	0.53	0.15	0.08	0.20			0.02	5.9
	2.65	0.55	0.15	0.08	0.22			0.02	6.6
	2.50	0.54	0.15	0.12	0.22			0.03	9.8
	2.35	0.55	0.15	0.12	0.22			0.03	10.2
	2.20	0.54	0.30	0.12	0.24			0.03	11.0
	2.05	0.54	0.15	0.07	0.22			0.01	5.6
	1.95	0.54	0.10	0.08	0.18			0.01	5.3
	1.85	0.54	0.10	0.09	0.19			0.02	6.6
	1.75	0.52	0.20	0.09	0.16			0.01	5.6
rock US	1.60	0.50	0.15	0.08	0.20			0.02	5.7
rock US	1.45	0.49	0.15	0.06	0.16			0.01	3.6
LB	1.35	0.00	0.10	0.00	0.00			0.00	0.0
Total Q								**0.27**	**100.0**

Appendix A-3. Manual Flow Measurements at Roberts Hydro in 2012

Date Monitored: 8-Jun-12 **Discharge:** 2.33 m³/s

Start Time (24 hr):

End Time (24 hr): 12:20

Personnel: Craig Hatt and Danielle Meyok

Method: Velocity-Area

Instrument: Hach FH950 with top setting rod

Stage: 99.415

Notes	Station (m)	Depth (m)	Distance (m)	Area (m^2)	Velocity (m/s) 60%	Velocity (m/s) 20%	Velocity (m/s) 80%	Q (m^3/s)	% of Total Q
Right bank	1.90	0.00	0.0	0.01	0.00			0.00	0.0
	2.20	0.07	0.3	0.03	0.06			0.00	0.1
	2.70	0.06	0.5	0.03	0.09			0.00	0.1
	3.20	0.08	0.5	0.04	0.07			0.00	0.1
	3.70	0.10	0.5	0.04	0.34			0.01	0.6
	4.00	0.17	0.3	0.07	0.54			0.04	1.6
	4.50	0.23	0.5	0.12	0.29			0.03	1.4
	5.00	0.25	0.5	0.09	0.01			0.00	0.0
	5.20	0.72	0.2	0.13	0.21			0.03	1.1
	5.35	0.73	0.1	0.11	0.89			0.10	4.2
	5.50	0.73	0.2	0.11	0.98			0.11	4.6
	5.65	0.72	0.2	0.11	0.92			0.10	4.3
	5.80	0.72	0.1	0.11	0.97			0.10	4.5
	5.95	0.75	0.2	0.11	0.90			0.10	4.3
	6.10	0.75	0.1	0.11	0.96			0.11	4.6
	6.25	0.73	0.2	0.11	0.94			0.10	4.4
	6.40	0.78	0.2	0.12	0.91			0.11	4.6
	6.55	0.80	0.1	0.10	0.91			0.09	3.9
	6.65	0.82	0.1	0.10		0.92	0.88	0.09	3.9
	6.80	0.80	0.1	0.12	0.95			0.11	4.9
	6.95	0.82	0.2	0.12		0.90	0.88	0.11	4.7
	7.10	0.70	0.1	0.11	0.96			0.10	4.3
	7.25	0.74	0.2	0.11	0.97			0.11	4.6
	7.40	0.72	0.2	0.11		0.96	0.89	0.10	4.3
	7.55	0.82	0.1	0.12		0.95	0.92	0.11	4.9
	7.70	0.80	0.2	0.12	1.00			0.12	5.2
	7.85	0.78	0.1	0.10	1.24			0.12	5.2
	7.95	0.77	0.1	0.10	1.04			0.10	4.3
	8.10	0.72	0.1	0.11	0.75			0.08	3.5
	8.25	0.72	0.2	0.13	0.41			0.05	2.2
	8.45	0.35	0.2	0.10	0.25			0.02	1.0
	8.80	0.25	0.4	0.11	0.25			0.03	1.2
	9.30	0.14	0.5	0.05	0.35			0.02	0.8
	9.55	0.12	0.3	0.04	0.42			0.01	0.6
Left bank	9.90	0.00	0.4	0.02	0.00			0.00	0.0
Total Q								**2.33**	100.0

Appendix A-3. Manual Flow Measurements at Roberts Hydro in 2012

Date Monitored:	14-Jun-12	**Mean Discharge Q (m^3/s):**	**4.20**
Start Time (24 hr):		**% Q Measured:**	51.4
End Time (24 hr):		**Error (StDev in m^3/s):**	0.07
Personnel:	Craig Hatt and Field Assistant	**Stage:**	99.499
Method:	Velocity-Area		
Instrument:	Acoustic Doppler Current Profiler		

	Discharge Q (m^3/s)						% Q	% Bad	
Transect	**Top**	**Mid**	**Bottom**	**Left**	**Right**	**Total Q**	**Measured**	**Ens**	**Bins**
1	0.81	2.20	0.67	0.30	0.15	4.14	53.2	0	0
2	0.75	2.23	0.62	0.47	0.15	4.21	52.9	11	1
3	0.79	2.09	0.63	0.45	0.19	4.15	50.4	13	0
4	0.82	2.11	0.63	0.61	0.14	4.30	49.0	10	0
Mean	0.79	2.16	0.64	0.46	0.16	**4.20**	51.4	8.5	0.3

Date Monitored:	26-Jul-12	**Discharge:**	0.51 m^3/s
Start Time (24 hr):	15:10		
End Time (24 hr):	15:40		
Personnel:	Natasha Cowie and Cathy Anablak		
Method:	Velocity-Area		
Instrument:	Flow Mate 2000 with top setting rod		
Stage:	99.159		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**Total Q**
Right bank	1.25	0.00	0.0	0.00	0.00			0.00	0.0
	1.30	0.11	0.1	0.01	0.05			0.00	0.1
	1.45	0.12	0.2	0.02	0.31			0.01	1.1
	1.60	0.12	0.2	0.02	0.60			0.01	2.1
	1.75	0.17	0.2	0.03	0.70			0.02	3.5
	1.90	0.20	0.2	0.03	0.68			0.02	4.0
	2.05	0.22	0.2	0.03	0.54			0.02	3.5
	2.20	0.24	0.2	0.04	0.47			0.02	3.3
	2.35	0.26	0.2	0.04	0.32			0.01	2.4
	2.50	0.28	0.2	0.04	0.19			0.01	1.6
	2.65	0.30	0.2	0.05	0.06			0.00	0.5
	2.80	0.33	0.2	0.05	0.12			0.01	1.2
	2.95	0.36	0.2	0.05	0.57			0.03	6.0
	3.10	0.42	0.2	0.06	0.85			0.05	10.4
	3.25	0.45	0.2	0.07	0.66			0.04	8.7
	3.40	0.50	0.2	0.08	0.91			0.07	13.3
	3.55	0.54	0.2	0.08	1.06			0.09	16.7
	3.70	0.50	0.2	0.07	0.81			0.06	11.0
	3.83	0.48	0.1	0.07	0.66			0.05	9.2
	4.00	0.46	0.2	0.07	0.26			0.02	3.7
	4.15	0.42	0.2	0.06	-0.07			0.00	-0.9
	4.30	0.42	0.1	0.06	-0.08			-0.01	-1.0
	4.45	0.44	0.2	0.07	-0.03			0.00	-0.4
Left bank	4.60	0.00	0.1	0.00	0.00			0.00	0.0
Total Q								**0.51**	100.0

Appendix A-3. Manual Flow Measurements at Roberts Hydro in 2012

Date Monitored: 10-Sep-12 **Discharge:** 0.11 m³/s
Start Time (24 hr): 15:50
End Time (24 hr): 16:40
Personnel: Natasha Cowie and Leonard Wingnek
Method: Velocity-Area
Instrument: Hach FH950 with top setting rod
Stage: 99.006

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	Total Q
RB	2.10	0.00	0.0	0.00	0.00			0.00	0.0
	2.20	0.16	0.1	0.02	-0.02			0.00	-0.3
	2.35	0.16	0.2	0.02	-0.05			0.00	-1.0
	2.50	0.13	0.2	0.02	-0.08			0.00	-1.4
	2.65	0.14	0.2	0.02	-0.09			0.00	-1.6
	2.80	0.14	0.2	0.02	-0.09			0.00	-1.7
	2.95	0.16	0.2	0.02	-0.07			0.00	-1.6
	3.10	0.16	0.2	0.03	-0.06			0.00	-1.6
	3.30	0.16	0.2	0.03	-0.07			0.00	-2.1
	3.50	0.16	0.2	0.02	0.08			0.00	1.7
	3.60	0.19	0.1	0.02	0.06			0.00	1.1
	3.70	0.21	0.1	0.02	0.08			0.00	1.5
	3.80	0.24	0.1	0.02	0.28			0.01	5.9
	3.90	0.24	0.1	0.02	0.37			0.01	7.8
	4.00	0.27	0.1	0.02	0.59			0.01	10.7
	4.05	0.28	0.0	0.01	0.58			0.01	7.3
	4.10	0.30	0.0	0.02	0.68			0.01	9.1
	4.15	0.30	0.1	0.02	0.79			0.01	10.6
	4.20	0.30	0.0	0.01	0.74			0.01	9.9
	4.25	0.28	0.0	0.01	0.72			0.01	9.0
	4.30	0.27	0.0	0.01	0.63			0.01	7.5
	4.35	0.30	0.0	0.02	0.65			0.01	8.7
	4.40	0.28	0.1	0.01	0.54			0.01	6.7
	4.45	0.28	0.0	0.01	0.42			0.01	5.2
	4.50	0.27	0.0	0.02	0.33			0.01	6.0
	4.60	0.27	0.1	0.03	0.26			0.01	6.3
	4.70	0.27	0.1	0.03	0.18			0.00	4.3
	4.80	0.26	0.1	0.03	0.04			0.00	1.2
	4.95	0.26	0.2	0.04	-0.07			0.00	-2.4
	5.10	0.22	0.1	0.03	-0.09			0.00	-2.7
	5.25	0.20	0.2	0.04	-0.12			0.00	-4.1
LB	5.50	0.00	0.0	0.00	0.00			0.00	0.0
Total Q								**0.11**	100.0

Appendix A-4. Manual Flow Measurements at Windy Hydro in 2012

Date Monitored: 8-Jun-12 **Discharge:** 0.32 m^3/s
Start Time (24 hr): 15:15
End Time (24 hr): 15:45
Personnel: Craig Hatt and Danielle Meyok
Method: Velocity-Area
Instrument: Hach FH950 with top setting rod
Stage: 95.140

Notes	Station (m)	Depth (m)	Distance (m)	Area (m^2)	Velocity (m/s) 60%	20%	80%	Q (m^3/s)	% of Total Q
RB	1.00	0.00	0.0	0.00	0.00			0.00	0.0
	1.20	0.04	0.2	0.01	0.02			0.00	0.0
	1.40	0.10	0.2	0.02	0.02			0.00	0.1
	1.50	0.16	0.1	0.01	0.36			0.00	1.3
	1.55	0.22	0.1	0.01	0.68			0.01	2.3
	1.60	0.60	0.1	0.03	0.71			0.02	6.6
	1.65	0.62	0.0	0.03	0.89			0.03	8.5
	1.70	0.63	0.1	0.03	0.95			0.03	9.3
	1.75	0.64	0.1	0.03	0.84			0.03	8.4
	1.80	0.64	0.1	0.03	0.71			0.02	7.0
	1.85	0.63	0.1	0.03	0.65			0.02	6.3
	1.90	0.64	0.0	0.03	0.70			0.02	7.0
	1.95	0.62	0.1	0.03	0.86			0.03	8.3
	2.00	0.62	0.1	0.03	0.81			0.02	7.8
	2.05	0.62	0.0	0.03	0.79			0.02	7.6
	2.10	0.62	0.1	0.03	0.79			0.02	7.6
	2.15	0.50	0.0	0.03	0.70			0.02	5.4
	2.20	0.58	0.1	0.03	0.55			0.02	5.0
	2.25	0.56	0.0	0.03	0.07			0.00	0.6
	2.30	0.54	0.0	0.04	0.05			0.00	0.6
	2.40	0.10	0.1	0.01	-0.01			0.00	0.0
LB	2.50	0.00	0.1	0.01	0.00			0.00	0.0
Total Q								**0.32**	100.0

Appendix A-4. Manual Flow Measurements at Windy Hydro in 2012

Date Monitored: 12-Jun-12 **Discharge:** 0.34 m^3/s
Start Time (24 hr): 15:15
End Time (24 hr): 15:45
Personnel: Craig Hatt and Field Assistant
Method: Velocity-Area
Instrument: Hach FH950 with top setting rod
Stage: 95.142

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	Total Q
RB	1.00	0.00	0.0	0.00	0.00			0.00	0.0
	1.20	0.04	0.2	0.01	0.01			0.00	0.0
	1.35	0.10	0.2	0.01	0.01			0.00	0.0
	1.40	0.13	0.0	0.01	0.01			0.00	0.0
	1.45	0.16	0.1	0.01	0.07			0.00	0.2
	1.50	0.19	0.1	0.01	0.37			0.00	1.0
	1.55	0.24	0.1	0.01	0.37			0.00	1.3
	1.60	0.61	0.1	0.03	0.82			0.02	7.2
	1.65	0.62	0.0	0.03	0.97			0.03	8.7
	1.70	0.65	0.1	0.05	0.88			0.04	12.5
	1.80	0.64	0.1	0.05	0.59			0.03	8.3
	1.85	0.65	0.1	0.03	0.69			0.02	6.6
	1.90	0.64	0.0	0.03	0.88			0.03	8.0
	1.95	0.64	0.1	0.03	0.90			0.03	8.4
	2.00	0.64	0.1	0.03	0.86			0.03	8.0
	2.05	0.64	0.0	0.03	0.81			0.03	7.6
	2.10	0.62	0.1	0.03	0.84			0.03	7.6
	2.15	0.62	0.0	0.03	0.81			0.02	7.3
	2.20	0.61	0.1	0.03	0.75			0.02	6.7
	2.25	0.57	0.0	0.03	0.08			0.00	0.6
	2.30	0.51	0.0	0.03	0.01			0.00	0.0
	2.35	0.17	0.1	0.01	0.04			0.00	0.1
	2.40	0.09	0.0	0.01	-0.07			0.00	-0.1
	2.50	0.05	0.1	0.01	-0.05			0.00	-0.1
LB	2.60	0.00	0.1	0.00	0.00			0.00	0.0
Total Q								**0.34**	100.0

Appendix A-4. Manual Flow Measurements at Windy Hydro in 2012

Date Monitored: 26-Jul-12 **Discharge:** 0.14 m^3/s

Start Time (24 hr): 12:08

End Time (24 hr): 12:45

Personnel: Natasha Cowie and Cathy Anablak

Method: Velocity-Area

Instrument: Flow Mate 2000 with top setting rod

Stage: 95.046

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	Total Q
LB	4.50	0.00	0.00	0.00	0.00			0.00	0.0
vegetation US	4.54	0.44	0.04	0.02	0.00			0.00	0.0
vegetation US	4.58	0.44	0.04	0.02	0.00			0.00	0.0
	4.62	0.45	0.04	0.02	0.05			0.00	0.6
	4.66	0.46	0.04	0.02	0.21			0.00	2.8
	4.70	0.46	0.04	0.02	0.35			0.01	4.6
	4.74	0.47	0.04	0.02	0.35			0.01	4.7
	4.78	0.47	0.04	0.02	0.45			0.01	6.0
	4.82	0.48	0.04	0.02	0.53			0.01	7.3
	4.86	0.49	0.04	0.02	0.62			0.01	8.7
	4.90	0.49	0.04	0.02	0.67			0.01	9.4
	4.94	0.48	0.04	0.02	0.49			0.01	6.7
	4.98	0.49	0.04	0.02	0.34			0.01	4.8
rock US	5.02	0.50	0.04	0.02	0.32			0.01	4.6
	5.06	0.49	0.04	0.02	0.24			0.00	3.4
	5.10	0.50	0.04	0.02	0.31			0.01	4.4
	5.14	0.49	0.04	0.02	0.60			0.01	8.4
	5.18	0.50	0.04	0.02	0.63			0.01	9.0
	5.22	0.47	0.04	0.02	0.52			0.01	7.0
	5.26	0.46	0.04	0.02	0.38			0.01	5.0
	5.30	0.46	0.04	0.02	0.22			0.00	2.9
RB	5.34	0.00	0.04	0.00	0.00			0.00	0.0
Total Q								**0.14**	100.0

Appendix A-4. Manual Flow Measurements at Windy Hydro in 2012

Date Monitored: 12-Sep-12 **Discharge:** 0.06 m^3/s
Start Time (24 hr): 9:20
End Time (24 hr): 10:10
Personnel: Natasha Cowie and Leonard Wingnek
Method: Velocity-Area
Instrument: Hach FH950 with top setting rod
Stage: 94.966

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**Total Q**
Right bank	1.85	0.00	0.00	0.00	0.00			0.00	0.0
Vegetation upstream	1.80	0.24	0.05	0.01	0.05			0.00	0.9
Vegetation upstream	1.76	0.24	0.04	0.01	0.06			0.00	0.9
	1.72	0.25	0.04	0.01	0.44			0.00	5.2
	1.70	0.26	0.02	0.01	0.53			0.00	4.3
	1.68	0.24	0.02	0.00	0.52			0.00	4.0
	1.66	0.26	0.02	0.01	0.56			0.00	4.6
	1.64	0.24	0.02	0.00	0.55			0.00	4.2
	1.62	0.25	0.02	0.00	0.56			0.00	4.4
	1.60	0.25	0.02	0.01	0.58			0.00	4.6
	1.58	0.26	0.02	0.01	0.56			0.00	4.6
	1.56	0.24	0.02	0.00	0.58			0.00	4.4
	1.54	0.25	0.02	0.01	0.55			0.00	4.3
	1.52	0.24	0.02	0.00	0.61			0.00	4.6
	1.50	0.24	0.02	0.00	0.57			0.00	4.3
	1.48	0.24	0.02	0.00	0.61			0.00	4.6
	1.46	0.24	0.02	0.00	0.56			0.00	4.3
	1.44	0.23	0.02	0.01	0.60			0.00	6.5
	1.40	0.23	0.04	0.01	0.58			0.00	6.3
	1.38	0.23	0.02	0.00	0.56			0.00	4.0
	1.36	0.23	0.02	0.01	0.53			0.00	5.7
	1.32	0.22	0.04	0.01	0.39			0.00	4.1
	1.30	0.22	0.02	0.00	0.36			0.00	2.5
	1.28	0.22	0.02	0.00	0.31			0.00	2.1
Vegetation upstream	1.26	0.22	0.02	0.00	0.23			0.00	1.6
Vegetation upstream	1.24	0.21	0.02	0.01	0.14			0.00	1.4
Vegetation upstream	1.20	0.19	0.04	0.01	0.10			0.00	1.2
Vegetation upstream	1.16	0.18	0.04	0.01	0.03			0.00	0.3
Vegetation upstream	1.12	0.14	0.04	0.01	0.01			0.00	0.1
Left bank	1.08	0.00	0.00	0.00	0.00			0.00	0.0
Total Q								**0.06**	100.0

Appendix B

2012 Daily Mean Water Levels for Monitored Lakes in the Doris North Project Area

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Appendix B-1. Summary of Daily Mean Water Level (m) at Doris Lake Station in 2012

Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)
1-Jan	*98.096*	2-Mar	*97.979*	2-May	*97.981*	2-Jul	98.280	1-Sep	97.847	1-Nov	
2-Jan	*98.096*	3-Mar	*97.957*	3-May	*98.011*	3-Jul	98.269	2-Sep	97.846	2-Nov	
3-Jan	*97.926*	4-Mar	*97.907*	4-May	*97.987*	4-Jul	98.259	3-Sep	97.841	3-Nov	
4-Jan	*97.876*	5-Mar	*97.916*	5-May	*97.949*	5-Jul	98.247	4-Sep	97.839	4-Nov	
5-Jan	*97.952*	6-Mar	*97.915*	6-May	*97.957*	6-Jul	98.236	5-Sep	97.839	5-Nov	
6-Jan	*97.868*	7-Mar	*97.895*	7-May	*97.968*	7-Jul	98.226	6-Sep	97.836	6-Nov	
7-Jan	*97.909*	8-Mar	*97.898*	8-May	*97.981*	8-Jul	98.217	7-Sep	97.830	7-Nov	
8-Jan	*97.843*	9-Mar	*97.963*	9-May	*97.945*	9-Jul	98.205	8-Sep		8-Nov	
9-Jan	*97.894*	10-Mar	*97.899*	10-May	*97.816*	10-Jul	98.192	9-Sep		9-Nov	
10-Jan	*97.951*	11-Mar	*97.933*	11-May	*97.776*	11-Jul	98.181	10-Sep		10-Nov	
11-Jan	*97.974*	12-Mar	*98.009*	12-May	*97.810*	12-Jul	98.170	11-Sep		11-Nov	
12-Jan	*97.989*	13-Mar	*97.942*	13-May	*97.935*	13-Jul	98.157	12-Sep		12-Nov	
13-Jan	*97.923*	14-Mar	*97.816*	14-May	*98.052*	14-Jul	98.144	13-Sep		13-Nov	
14-Jan	*97.948*	15-Mar	*97.875*	15-May	*98.036*	15-Jul	98.133	14-Sep		14-Nov	
15-Jan	*98.005*	16-Mar	*97.952*	16-May	*98.029*	16-Jul	98.123	15-Sep		15-Nov	
16-Jan	*97.964*	17-Mar	*97.979*	17-May	*98.030*	17-Jul	98.113	16-Sep		16-Nov	
17-Jan	*97.876*	18-Mar	*98.009*	18-May	*98.017*	18-Jul	98.102	17-Sep		17-Nov	
18-Jan	*97.709*	19-Mar	*98.080*	19-May	*97.998*	19-Jul	98.086	18-Sep		18-Nov	
19-Jan	*97.763*	20-Mar	*98.108*	20-May	*97.953*	20-Jul	98.077	19-Sep		19-Nov	
20-Jan	*97.907*	21-Mar	*98.012*	21-May	*97.938*	21-Jul	98.067	20-Sep		20-Nov	
21-Jan	*97.930*	22-Mar	*97.958*	22-May	*97.920*	22-Jul	98.055	21-Sep		21-Nov	
22-Jan	*97.991*	23-Mar	*98.021*	23-May	*97.871*	23-Jul	98.057	22-Sep		22-Nov	
23-Jan	*98.036*	24-Mar	*98.041*	24-May	*97.924*	24-Jul	98.049	23-Sep		23-Nov	
24-Jan	*98.009*	25-Mar	*97.941*	25-May	*97.970*	25-Jul	98.038	24-Sep		24-Nov	
25-Jan	*97.954*	26-Mar	*97.850*	26-May	*97.913*	26-Jul	98.031	25-Sep		25-Nov	
26-Jan	*97.882*	27-Mar	*97.880*	27-May	*97.914*	27-Jul	98.021	26-Sep		26-Nov	
27-Jan	*97.849*	28-Mar	*97.888*	28-May	*97.927*	28-Jul	98.017	27-Sep		27-Nov	
28-Jan	*98.006*	29-Mar	*97.851*	29-May	*97.875*	29-Jul	98.008	28-Sep		28-Nov	
29-Jan	*98.088*	30-Mar	*97.890*	30-May	*97.871*	30-Jul	98.000	29-Sep		29-Nov	
30-Jan	*97.993*	31-Mar	*97.867*	31-May	*97.860*	31-Jul	97.991	30-Sep		30-Nov	
31-Jan	*97.914*	1-Apr	*97.882*	1-Jun	97.919	1-Aug	97.983	1-Oct		1-Dec	
1-Feb	*97.873*	2-Apr	*97.940*	2-Jun	97.957	2-Aug	97.975	2-Oct		2-Dec	
2-Feb	*97.940*	3-Apr	*97.950*	3-Jun	98.025	3-Aug	97.967	3-Oct		3-Dec	
3-Feb	*97.886*	4-Apr	*97.969*	4-Jun	98.056	4-Aug	97.960	4-Oct		4-Dec	
4-Feb	*97.927*	5-Apr	*97.931*	5-Jun	98.085	5-Aug	97.952	5-Oct		5-Dec	
5-Feb	*97.965*	6-Apr	*97.951*	6-Jun	98.123	6-Aug	97.946	6-Oct		6-Dec	
6-Feb	*98.150*	7-Apr	*98.007*	7-Jun	98.220	7-Aug	97.939	7-Oct		7-Dec	
7-Feb	*97.977*	8-Apr	*98.021*	8-Jun	98.317	8-Aug	97.933	8-Oct		8-Dec	
8-Feb	*98.015*	9-Apr	*98.074*	9-Jun	98.376	9-Aug	97.928	9-Oct		9-Dec	
9-Feb	*98.029*	10-Apr	*98.018*	10-Jun	98.416	10-Aug	97.924	10-Oct		10-Dec	
10-Feb	*98.036*	11-Apr	*97.893*	11-Jun	98.440	11-Aug	97.916	11-Oct		11-Dec	
11-Feb	*97.873*	12-Apr	*97.928*	12-Jun	98.452	12-Aug	97.910	12-Oct		12-Dec	
12-Feb	*97.746*	13-Apr	*97.945*	13-Jun	98.456	13-Aug	97.906	13-Oct		13-Dec	
13-Feb	*97.765*	14-Apr	*97.975*	14-Jun	98.454	14-Aug	97.898	14-Oct		14-Dec	
14-Feb	*97.856*	15-Apr	*98.011*	15-Jun	98.450	15-Aug	97.891	15-Oct		15-Dec	
15-Feb	*97.906*	16-Apr	*97.949*	16-Jun	98.445	16-Aug	97.884	16-Oct		16-Dec	
16-Feb	*97.980*	17-Apr	*97.913*	17-Jun	98.439	17-Aug	97.880	17-Oct		17-Dec	
17-Feb	*98.019*	18-Apr	*97.906*	18-Jun	98.435	18-Aug	97.875	18-Oct		18-Dec	
18-Feb	*97.891*	19-Apr	*97.911*	19-Jun	98.428	19-Aug	97.872	19-Oct		19-Dec	
19-Feb	*97.988*	20-Apr	*97.898*	20-Jun	98.421	20-Aug	97.866	20-Oct		20-Dec	
20-Feb	*98.064*	21-Apr	*97.864*	21-Jun	98.412	21-Aug	97.862	21-Oct		21-Dec	
21-Feb	*97.979*	22-Apr	*97.943*	22-Jun	98.401	22-Aug	97.865	22-Oct		22-Dec	
22-Feb	*97.851*	23-Apr	*98.011*	23-Jun	98.390	23-Aug	97.863	23-Oct		23-Dec	
23-Feb	*97.875*	24-Apr	*98.022*	24-Jun	98.380	24-Aug	97.861	24-Oct		24-Dec	
24-Feb	*98.006*	25-Apr	*97.992*	25-Jun	98.368	25-Aug	97.859	25-Oct		25-Dec	
25-Feb	*98.056*	26-Apr	*98.008*	26-Jun	98.355	26-Aug	97.856	26-Oct		26-Dec	
26-Feb	*98.078*	27-Apr	*97.935*	27-Jun	98.342	27-Aug	97.857	27-Oct		27-Dec	
27-Feb	*98.022*	28-Apr	*97.857*	28-Jun	98.329	28-Aug	97.855	28-Oct		28-Dec	
28-Feb	*97.900*	29-Apr	*97.727*	29-Jun	98.317	29-Aug	97.854	29-Oct		29-Dec	
29-Feb	*97.946*	30-Apr	*97.791*	30-Jun	98.304	30-Aug	97.853	30-Oct		30-Dec	
1-Mar	*97.954*	1-May	*97.908*	1-Jul	98.291	31-Aug	97.851	31-Oct		31-Dec	

Note: lake water levels affected by ice conditions are italicized

Appendix B-2. Summary of Daily Mean Water Level (m) at Tail Lake Station in 2012

Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)
1-Jan	*94.226*	2-Mar	*94.236*	2-May	*94.242*	2-Jul	94.382	1-Sep	94.029	1-Nov	
2-Jan	*94.224*	3-Mar	*94.236*	3-May	*94.242*	3-Jul	94.375	2-Sep	94.026	2-Nov	
3-Jan	*94.221*	4-Mar	*94.236*	4-May	*94.240*	4-Jul	94.366	3-Sep	94.026	3-Nov	
4-Jan	*94.226*	5-Mar	*94.237*	5-May	*94.240*	5-Jul	94.358	4-Sep	94.020	4-Nov	
5-Jan	*94.221*	6-Mar	*94.236*	6-May	*94.240*	6-Jul	94.348	5-Sep	94.015	5-Nov	
6-Jan	*94.219*	7-Mar	*94.230*	7-May	*94.241*	7-Jul	94.338	6-Sep	94.014	6-Nov	
7-Jan	*94.220*	8-Mar	*94.230*	8-May	*94.241*	8-Jul	94.329	7-Sep	94.008	7-Nov	
8-Jan	*94.221*	9-Mar	*94.229*	9-May	*94.240*	9-Jul	94.319	8-Sep	94.004	8-Nov	
9-Jan	*94.221*	10-Mar	*94.230*	10-May	*94.246*	10-Jul	94.303	9-Sep	93.998	9-Nov	
10-Jan	*94.221*	11-Mar	*94.229*	11-May	*94.248*	11-Jul	94.289	10-Sep	93.993	10-Nov	
11-Jan	*94.221*	12-Mar	*94.230*	12-May	*94.251*	12-Jul	94.278	11-Sep	93.990	11-Nov	
12-Jan	*94.220*	13-Mar	*94.229*	13-May	*94.251*	13-Jul	94.267	12-Sep	93.986	12-Nov	
13-Jan	*94.219*	14-Mar	*94.231*	14-May	*94.258*	14-Jul	94.254	13-Sep		13-Nov	
14-Jan	*94.225*	15-Mar	*94.232*	15-May	*94.261*	15-Jul	94.244	14-Sep		14-Nov	
15-Jan	*94.227*	16-Mar	*94.232*	16-May	*94.263*	16-Jul	94.234	15-Sep		15-Nov	
16-Jan	*94.226*	17-Mar	*94.232*	17-May	*94.264*	17-Jul	94.223	16-Sep		16-Nov	
17-Jan	*94.220*	18-Mar	*94.232*	18-May	*94.265*	18-Jul	94.211	17-Sep		17-Nov	
18-Jan	*94.219*	19-Mar	*94.237*	19-May	*94.265*	19-Jul	94.197	18-Sep		18-Nov	
19-Jan	*94.218*	20-Mar	*94.236*	20-May	*94.267*	20-Jul	94.178	19-Sep		19-Nov	
20-Jan	*94.218*	21-Mar	*94.236*	21-May	*94.267*	21-Jul	94.181	20-Sep		20-Nov	
21-Jan	*94.218*	22-Mar	*94.237*	22-May	*94.268*	22-Jul	94.175	21-Sep		21-Nov	
22-Jan	*94.220*	23-Mar	*94.238*	23-May	*94.269*	23-Jul	94.165	22-Sep		22-Nov	
23-Jan	*94.221*	24-Mar	*94.237*	24-May	*94.270*	24-Jul	94.178	23-Sep		23-Nov	
24-Jan	*94.220*	25-Mar	*94.236*	25-May	*94.269*	25-Jul	94.174	24-Sep		24-Nov	
25-Jan	*94.220*	26-Mar	*94.237*	26-May	*94.269*	26-Jul	94.160	25-Sep		25-Nov	
26-Jan	*94.217*	27-Mar	*94.237*	27-May	94.271	27-Jul	94.157	26-Sep		26-Nov	
27-Jan	*94.218*	28-Mar	*94.236*	28-May	94.280	28-Jul	94.154	27-Sep		27-Nov	
28-Jan	*94.221*	29-Mar	*94.234*	29-May	94.299	29-Jul	94.153	28-Sep		28-Nov	
29-Jan	*94.220*	30-Mar	*94.233*	30-May	94.318	30-Jul	94.145	29-Sep		29-Nov	
30-Jan	*94.219*	31-Mar	*94.231*	31-May	94.329	31-Jul	94.142	30-Sep		30-Nov	
31-Jan	*94.220*	1-Apr	*94.231*	1-Jun	94.342	1-Aug	94.137	1-Oct		1-Dec	
1-Feb	*94.220*	2-Apr	*94.232*	2-Jun	94.356	2-Aug	94.132	2-Oct		2-Dec	
2-Feb	*94.219*	3-Apr	*94.233*	3-Jun	94.368	3-Aug	94.128	3-Oct		3-Dec	
3-Feb	*94.218*	4-Apr	*94.234*	4-Jun	94.387	4-Aug	94.122	4-Oct		4-Dec	
4-Feb	*94.224*	5-Apr	*94.240*	5-Jun	94.412	5-Aug	94.117	5-Oct		5-Dec	
5-Feb	*94.230*	6-Apr	*94.241*	6-Jun	94.433	6-Aug	94.110	6-Oct		6-Dec	
6-Feb	*94.232*	7-Apr	*94.242*	7-Jun	94.450	7-Aug	94.106	7-Oct		7-Dec	
7-Feb	*94.232*	8-Apr	*94.243*	8-Jun	94.461	8-Aug	94.102	8-Oct		8-Dec	
8-Feb	*94.234*	9-Apr	*94.243*	9-Jun	94.468	9-Aug	94.098	9-Oct		9-Dec	
9-Feb	*94.234*	10-Apr	*94.242*	10-Jun	94.475	10-Aug	94.095	10-Oct		10-Dec	
10-Feb	*94.233*	11-Apr	*94.242*	11-Jun	94.480	11-Aug	94.089	11-Oct		11-Dec	
11-Feb	*94.231*	12-Apr	*94.243*	12-Jun	94.482	12-Aug	94.083	12-Oct		12-Dec	
12-Feb	*94.225*	13-Apr	*94.243*	13-Jun	94.477	13-Aug	94.075	13-Oct		13-Dec	
13-Feb	*94.225*	14-Apr	*94.243*	14-Jun	94.473	14-Aug	94.069	14-Oct		14-Dec	
14-Feb	*94.226*	15-Apr	*94.243*	15-Jun	94.472	15-Aug	94.061	15-Oct		15-Dec	
15-Feb	*94.227*	16-Apr	*94.243*	16-Jun	94.468	16-Aug	94.056	16-Oct		16-Dec	
16-Feb	*94.229*	17-Apr	*94.243*	17-Jun	94.466	17-Aug	94.052	17-Oct		17-Dec	
17-Feb	*94.229*	18-Apr	*94.242*	18-Jun	94.461	18-Aug	94.049	18-Oct		18-Dec	
18-Feb	*94.232*	19-Apr	*94.242*	19-Jun	94.456	19-Aug	94.045	19-Oct		19-Dec	
19-Feb	*94.231*	20-Apr	*94.241*	20-Jun	94.455	20-Aug	94.038	20-Oct		20-Dec	
20-Feb	*94.235*	21-Apr	*94.241*	21-Jun	94.453	21-Aug	94.034	21-Oct		21-Dec	
21-Feb	*94.231*	22-Apr	*94.241*	22-Jun	94.449	22-Aug	94.036	22-Oct		22-Dec	
22-Feb	*94.232*	23-Apr	*94.241*	23-Jun	94.444	23-Aug	94.035	23-Oct		23-Dec	
23-Feb	*94.232*	24-Apr	*94.241*	24-Jun	94.438	24-Aug	94.032	24-Oct		24-Dec	
24-Feb	*94.234*	25-Apr	*94.240*	25-Jun	94.431	25-Aug	94.028	25-Oct		25-Dec	
25-Feb	*94.237*	26-Apr	*94.240*	26-Jun	94.425	26-Aug	94.026	26-Oct		26-Dec	
26-Feb	*94.237*	27-Apr	*94.239*	27-Jun	94.419	27-Aug	94.029	27-Oct		27-Dec	
27-Feb	*94.237*	28-Apr	*94.239*	28-Jun	94.413	28-Aug	94.029	28-Oct		28-Dec	
28-Feb	*94.237*	29-Apr	*94.239*	29-Jun	94.405	29-Aug	94.029	29-Oct		29-Dec	
29-Feb	*94.237*	30-Apr	*94.240*	30-Jun	94.398	30-Aug	94.030	30-Oct		30-Dec	
1-Mar	*94.236*	1-May	*94.241*	1-Jul	94.390	31-Aug	94.031	31-Oct		31-Dec	

Note: lake water levels affected by ice conditions are italicized

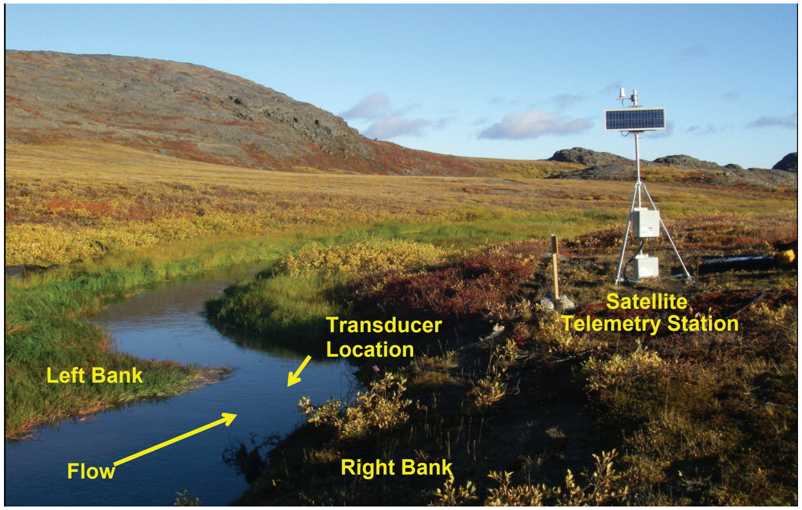
Appendix B-3. Summary of Daily Mean Water Level (m) at Windy Lake Station in 2012

Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)
1-Jan		2-Mar		2-May		2-Jul	95.123	1-Sep	94.990	1-Nov	
2-Jan		3-Mar		3-May		3-Jul	95.119	2-Sep	94.987	2-Nov	
3-Jan		4-Mar		4-May		4-Jul	95.116	3-Sep	94.988	3-Nov	
4-Jan		5-Mar		5-May		5-Jul	95.112	4-Sep	94.985	4-Nov	
5-Jan		6-Mar		6-May		6-Jul	95.108	5-Sep	94.982	5-Nov	
6-Jan		7-Mar		7-May		7-Jul	95.104	6-Sep	94.980	6-Nov	
7-Jan		8-Mar		8-May		8-Jul	95.101	7-Sep	94.979	7-Nov	
8-Jan		9-Mar		9-May		9-Jul	95.099	8-Sep	94.972	8-Nov	
9-Jan		10-Mar		10-May		10-Jul	95.097	9-Sep	94.971	9-Nov	
10-Jan		11-Mar		11-May		11-Jul	95.093	10-Sep	94.971	10-Nov	
11-Jan		12-Mar		12-May		12-Jul	95.090	11-Sep	94.967	11-Nov	
12-Jan		13-Mar		13-May		13-Jul	95.086	12-Sep	94.965	12-Nov	
13-Jan		14-Mar		14-May		14-Jul	95.083	13-Sep	94.963	13-Nov	
14-Jan		15-Mar		15-May		15-Jul	95.080	14-Sep		14-Nov	
15-Jan		16-Mar		16-May		16-Jul	95.079	15-Sep		15-Nov	
16-Jan		17-Mar		17-May		17-Jul	95.078	16-Sep		16-Nov	
17-Jan		18-Mar		18-May		18-Jul	95.077	17-Sep		17-Nov	
18-Jan		19-Mar		19-May		19-Jul	95.073	18-Sep		18-Nov	
19-Jan		20-Mar		20-May		20-Jul	95.069	19-Sep		19-Nov	
20-Jan		21-Mar		21-May		21-Jul	95.067	20-Sep		20-Nov	
21-Jan		22-Mar		22-May		22-Jul	95.066	21-Sep		21-Nov	
22-Jan		23-Mar		23-May		23-Jul	95.063	22-Sep		22-Nov	
23-Jan		24-Mar		24-May		24-Jul	95.059	23-Sep		23-Nov	
24-Jan		25-Mar		25-May		25-Jul	95.058	24-Sep		24-Nov	
25-Jan		26-Mar		26-May		26-Jul	95.054	25-Sep		25-Nov	
26-Jan		27-Mar		27-May		27-Jul	95.054	26-Sep		26-Nov	
27-Jan		28-Mar		28-May		28-Jul	95.051	27-Sep		27-Nov	
28-Jan		29-Mar		29-May		29-Jul	95.050	28-Sep		28-Nov	
29-Jan		30-Mar		30-May		30-Jul	95.046	29-Sep		29-Nov	
30-Jan		31-Mar		31-May		31-Jul	95.042	30-Sep		30-Nov	
31-Jan		1-Apr		1-Jun		1-Aug	95.039	1-Oct		1-Dec	
1-Feb		2-Apr		2-Jun		2-Aug	95.035	2-Oct		2-Dec	
2-Feb		3-Apr		3-Jun		3-Aug	95.032	3-Oct		3-Dec	
3-Feb		4-Apr		4-Jun		4-Aug	95.030	4-Oct		4-Dec	
4-Feb		5-Apr		5-Jun		5-Aug	95.026	5-Oct		5-Dec	
5-Feb		6-Apr		6-Jun		6-Aug	95.022	6-Oct		6-Dec	
6-Feb		7-Apr		7-Jun	95.057	7-Aug	95.020	7-Oct		7-Dec	
7-Feb		8-Apr		8-Jun	95.109	8-Aug	95.018	8-Oct		8-Dec	
8-Feb		9-Apr		9-Jun	95.126	9-Aug	95.017	9-Oct		9-Dec	
9-Feb		10-Apr		10-Jun	95.130	10-Aug	95.016	10-Oct		10-Dec	
10-Feb		11-Apr		11-Jun	95.133	11-Aug	95.015	11-Oct		11-Dec	
11-Feb		12-Apr		12-Jun	95.134	12-Aug	95.011	12-Oct		12-Dec	
12-Feb		13-Apr		13-Jun	95.136	13-Aug	95.009	13-Oct		13-Dec	
13-Feb		14-Apr		14-Jun	95.136	14-Aug	95.006	14-Oct		14-Dec	
14-Feb		15-Apr		15-Jun	95.137	15-Aug	95.001	15-Oct		15-Dec	
15-Feb		16-Apr		16-Jun	95.138	16-Aug	94.999	16-Oct		16-Dec	
16-Feb		17-Apr		17-Jun	95.138	17-Aug	94.995	17-Oct		17-Dec	
17-Feb		18-Apr		18-Jun	95.139	18-Aug	94.994	18-Oct		18-Dec	
18-Feb		19-Apr		19-Jun	95.140	19-Aug	94.992	19-Oct		19-Dec	
19-Feb		20-Apr		20-Jun	95.140	20-Aug	94.990	20-Oct		20-Dec	
20-Feb		21-Apr		21-Jun	95.142	21-Aug	94.986	21-Oct		21-Dec	
21-Feb		22-Apr		22-Jun	95.143	22-Aug	94.984	22-Oct		22-Dec	
22-Feb		23-Apr		23-Jun	95.143	23-Aug	94.988	23-Oct		23-Dec	
23-Feb		24-Apr		24-Jun	95.143	24-Aug	94.989	24-Oct		24-Dec	
24-Feb		25-Apr		25-Jun	95.142	25-Aug	94.989	25-Oct		25-Dec	
25-Feb		26-Apr		26-Jun	95.141	26-Aug	94.988	26-Oct		26-Dec	
26-Feb		27-Apr		27-Jun	95.138	27-Aug	94.988	27-Oct		27-Dec	
27-Feb		28-Apr		28-Jun	95.136	28-Aug	94.990	28-Oct		28-Dec	
28-Feb		29-Apr		29-Jun	95.133	29-Aug	94.991	29-Oct		29-Dec	
29-Feb		30-Apr		30-Jun	95.130	30-Aug	94.991	30-Oct		30-Dec	
1-Mar		1-May		1-Jul	95.126	31-Aug	94.990	31-Oct		31-Dec	

Appendix C

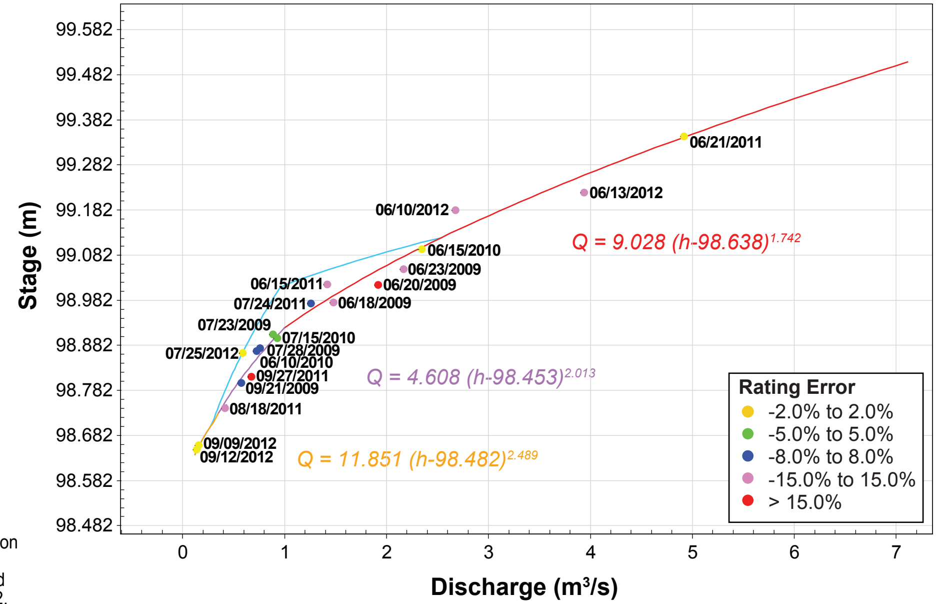
2012 Rating Curves and Channel Cross-Sections for Hydrometric Monitoring Stations in the Doris North Project Area

Rescan™
Engineers and Scientists

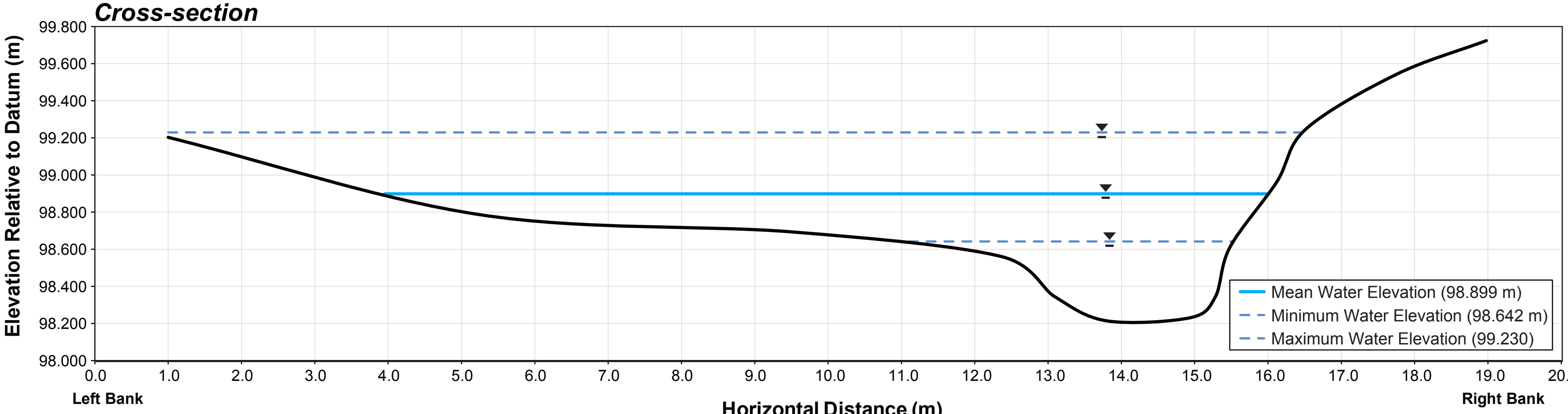


Hydrometric station Doris TL-2 (Doris Creek upstream location at Doris Lake outflow) looking downstream (northwest). The hydrometric station and satellite telemetry station are on the right bank. The flow gauging section is approximately 30 m downstream (not visible in this photo). Note the flood terrace on the left bank with thick grass. The channel overflows this flood terrace during high flow conditions. The grass creates artifically elevated stage readings in the summer, requiring a shift in the rating curve (blue line on rating curve). September 9, 2012.

Rating Curve



Cross-section

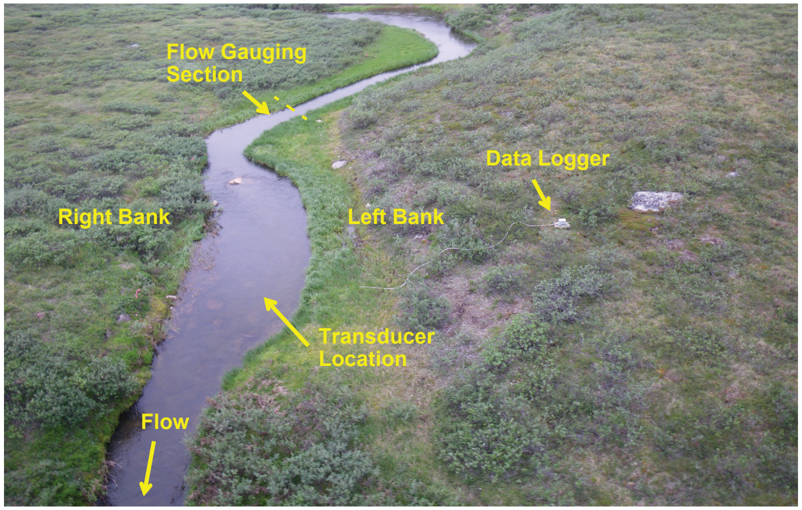


Note: Water levels are referenced to a site specific non-geodetic datum.

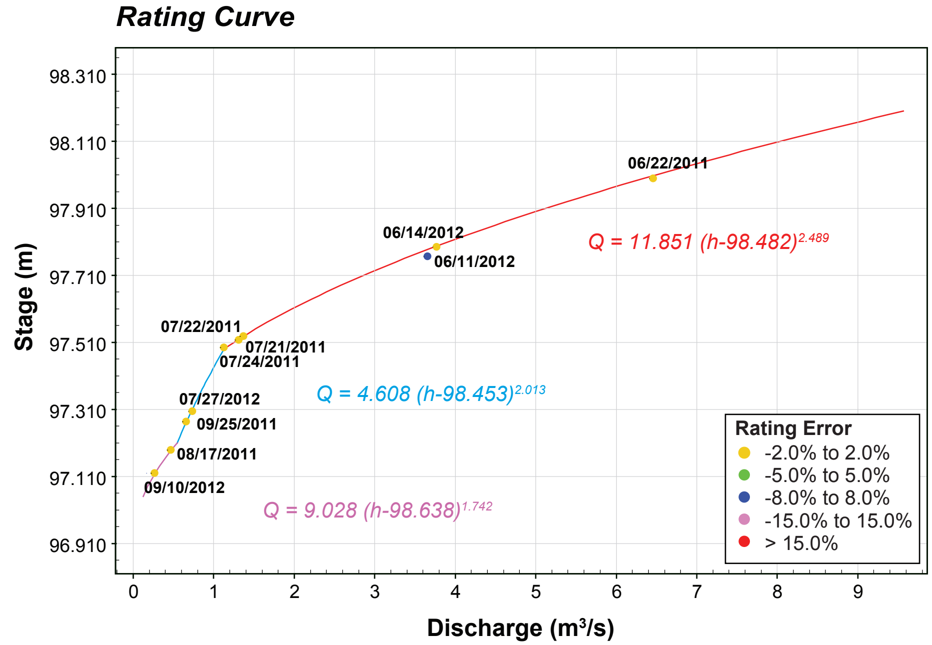
NEWMONT NORTH AMERICA

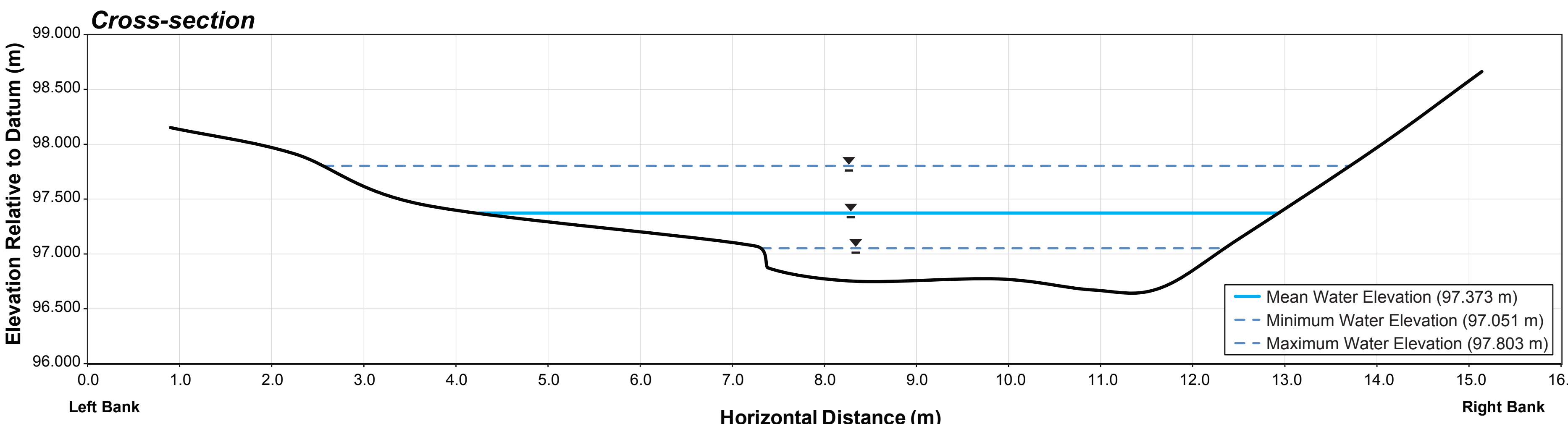
Doris TL-2 (Doris Lake Outflow) Stage-Discharge Rating Curve and Channel Cross-Section

Rescan Engineers & Scientists



Hydrometric station Doris TL-3 (Doris Creek downstream location) looking upstream (south). The hydrometric station is on the left bank. The flow gauging location is approximately 20 m upstream of the station. July 27, 2012.





Note: Water levels are referenced to a site specific non-geodetic datum.

NEWMONT NORTH AMERICA

Doris TL-3 (Doris Creek Downstream) Stage-Dischage Rating Curve and Channel Cross-Section

Figure C-2

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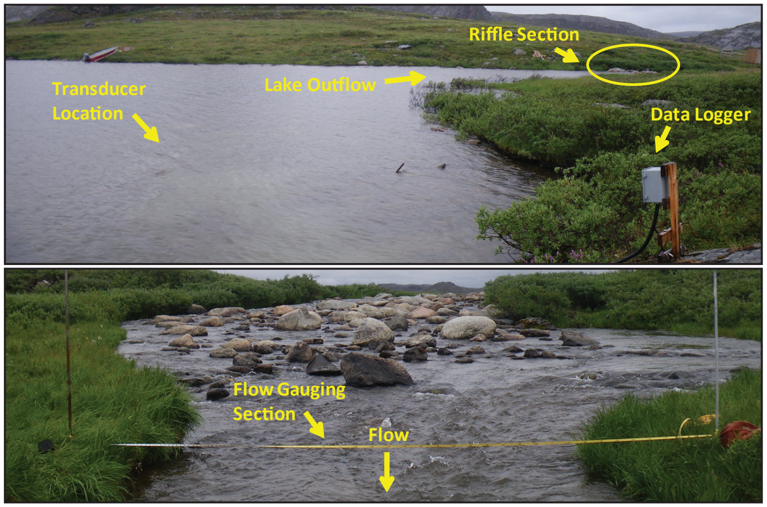
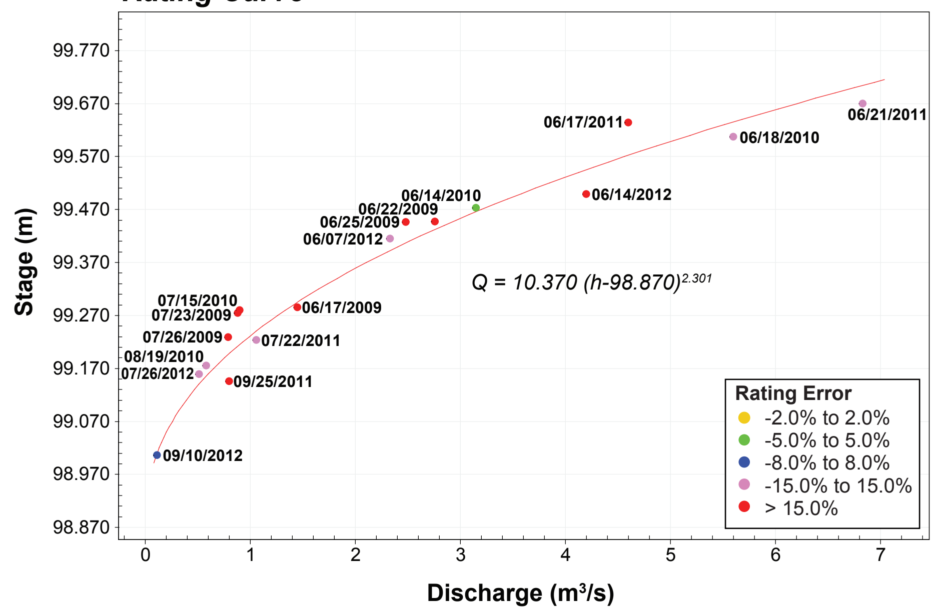
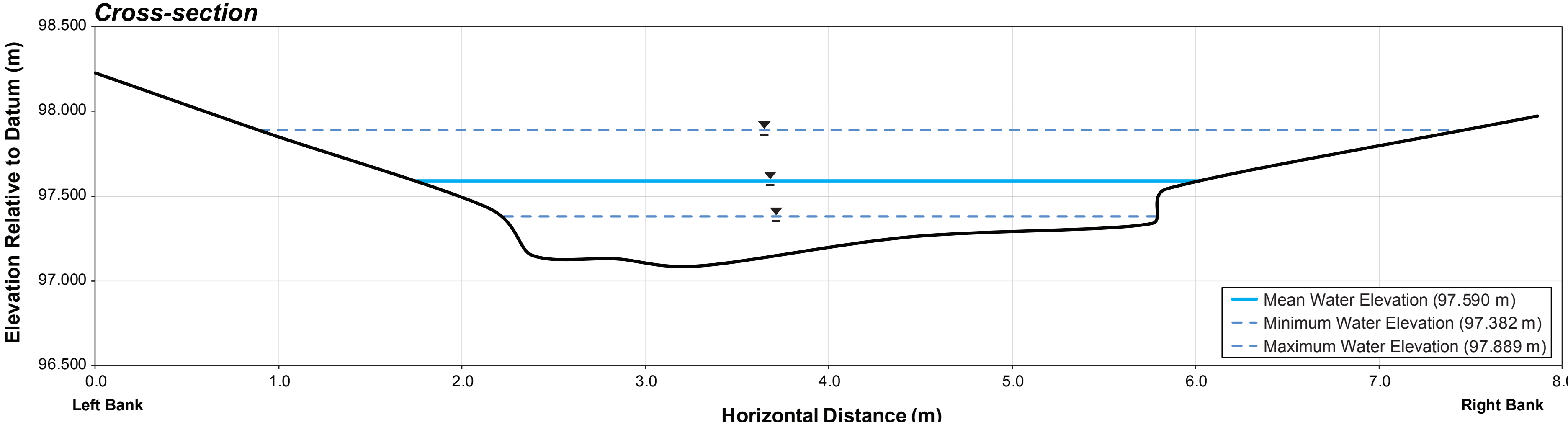


Top: Roberts Lake outflow (station Roberts Hydro) looking downstream (northwest). The hydrometric station is in the foreground. The yellow circle indicates a riffle section in the channel that controls the rate of water flowing from the lake. July 26, 2012. Bottom: Upstream view of the control section (riffle). The flow gauging section is immediately downstream of the riffle, approximately 150 m downstream of the lake outlet. July 26, 2012.

Rating Curve



Cross-section



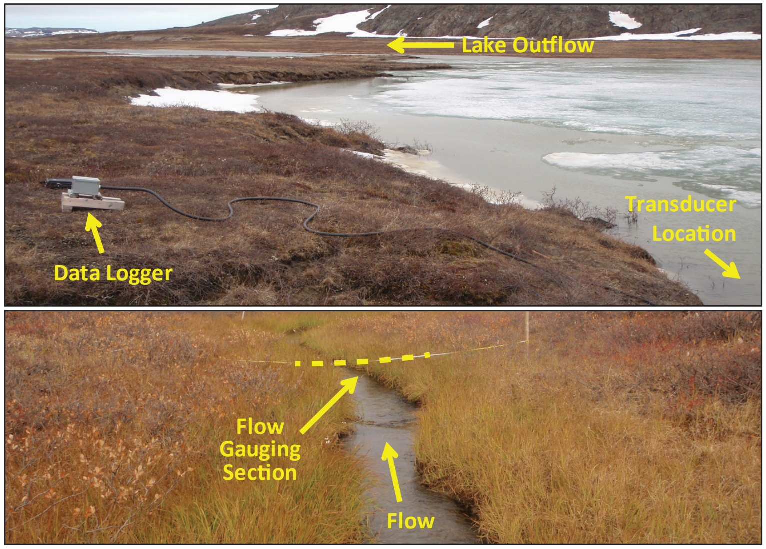
Note: Water levels are referenced to a site specific non-geodetic datum.

NEWMONT NORTH AMERICA

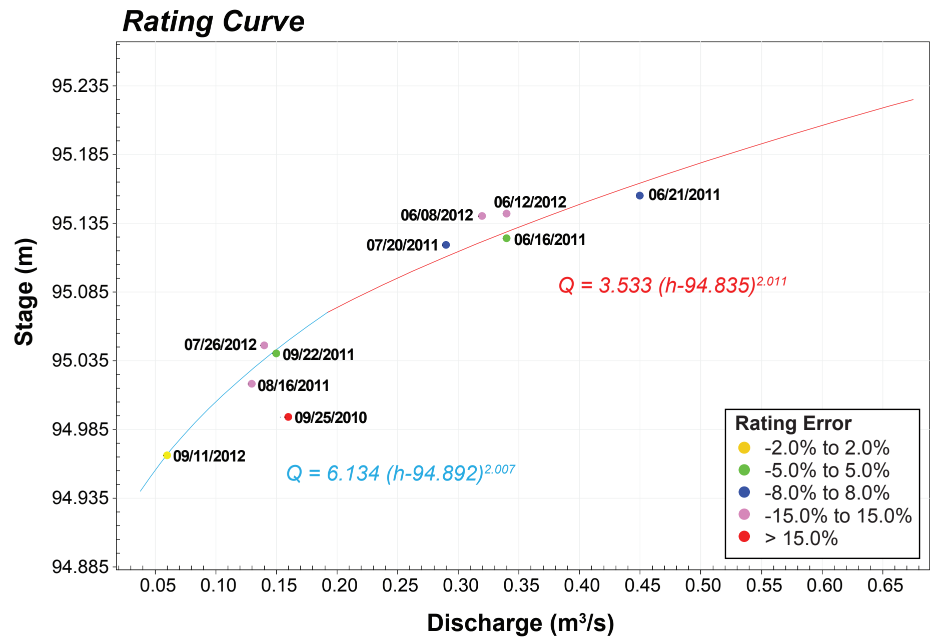
Roberts Hydro (Roberts Lake Outflow) Stage-Discharge Rating Curve and Channel Cross-Section

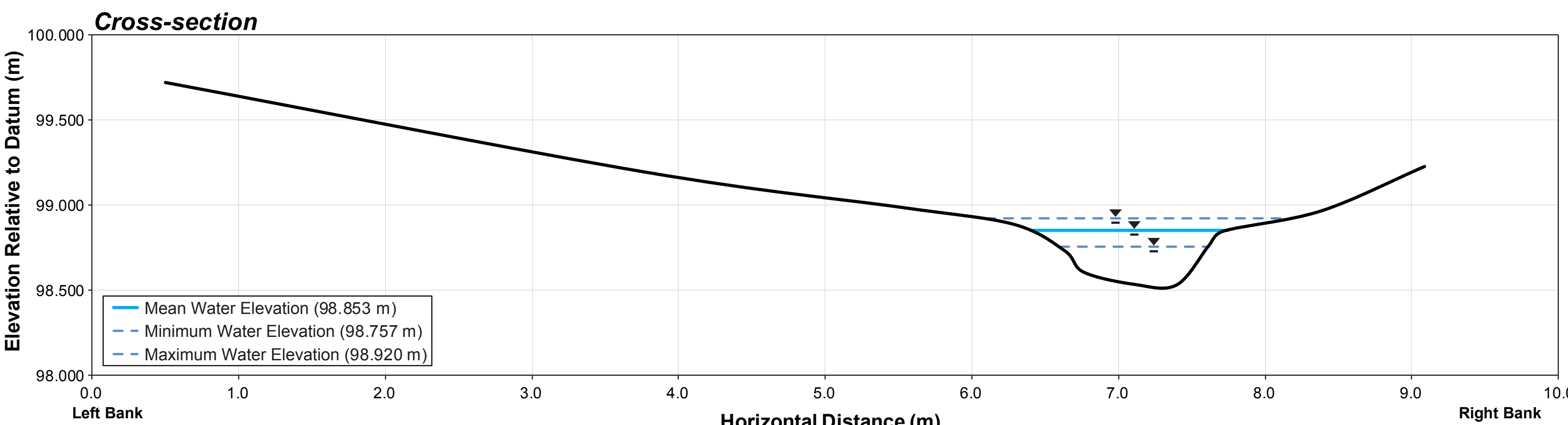
Figure C-3

Rescan Engineers & Scientists



Top: Windy Lake outflow (station Windy Hydro) looking downstream (northeast). The hydrometric station is in the foreground. June 12, 2012. Bottom: View of flow gauging section looking downstream (north). The flow gauging section is approximately 500 m downstream of the lake outlet. Under low discharge conditions (pictured), the flow is confined by the main channel. September 12, 2012.





Note: Hydraulic geometry surveyed relative to a local arbitrary datum.

NEWMONT NORTH AMERICA

Windy Hydro (Windy Lake Outflow) Stage-Discharge Rating Curve and Channel Cross-Section

Figure C-4

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Appendix D

Memorandum: Estimation of Maximum Allowable Water Discharges from the Tail Lake Impoundment Area into Doris Creek (TL-2)

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Memorandum

Refer to File No.: N:\1009 Hope Bay\1009-008 HBB Environmental Compliance\1009-008-04 Hydrology\Word Processing\2012 TL-2 Memo\0.2_1009-008-04_2012 Maximum Water Discharges.doc

DATE: November 30, 2012

TO: Angela Hopzapfel

FROM: Natasha Cowie

CC: Deborah Muggli; David Luzi

SUBJECT: Estimation of Maximum Allowable Water Discharges from the Tail Lake Impoundment Area into Doris Creek (TL-2)

---

1. Introduction

The purpose of this memorandum is to describe the methods used to calculate the allowable maximum daily volumes that could be discharged from the Tail Lake impoundment area into Doris Creek.

The integrity of an earth dam that impounds the waters from Tail Lake could have been compromised by the higher than normal water levels experienced during the freshet conditions in 2011. In order to avoid potential damage to the dam by rising water levels, Hope Bay Mining Ltd. (HBML) requested Rescan Environmental Services Ltd. (Rescan) to provide the allowable maximum daily volumes that could be discharged from Tail Lake into Doris Creek. In 2011, Rescan initiated a program to calculate allowable maximum daily discharge from Tail Lake into Doris Creek. This program was continued in 2012. This memorandum describes the methods and results of the 2012 program.

Any discharge of water from Tail Lake into Doris Creek needed to comply with the following regulatory requirement:

Doris North Gold Mine Project Type A Water License (2AM-DOH0713, issued September 19, 2007).

The license states in Part G, Section 30 that:

> "*The Licensee shall ensure that the flow from the Tailings Impoundment Area into Doris Creek at monitoring station TL-4 does not exceed 10% of the background flow in Doris Creek as measured at monitoring station TL-2 at the time of discharge.*"

The hydrometric station TL-2 located along the banks of Doris Creek was reactivated on June 9, 2012. Water level data (stage) were monitored and recorded every 10 minutes at the station. These data were uploaded every two hours to a web server via satellite link and downloaded on a daily basis to the Rescan head office located in Vancouver.

2. Methodology

At the end of the 2011 open water season, water discharges were determined from manual current velocity measurements conducted at Doris Creek (TL-2). The flow discharges were used to update the existing stage-discharge relationship for this site (Rescan 2011, 2012).

Water stage data were downloaded each day from station TL-2. Then, QA/QC procedures were followed to assure the integrity and validity of the information. The updated stage-discharge relationship was then applied to convert the stage data into a continuous discharge time-series or hydrograph. The mean daily discharges were determined from the hydrograph.

According to current regulatory requirements, the maximum daily discharge from Tail Lake cannot exceed 10% of the background flow at Doris Creek (TL-2). As a result, HBML personnel needed to know the mean daily discharge of Doris Creek before pumping from Tail Lake into Doris Creek began on a given day. Because the mean daily discharge for a particular day at the Doris Creek (TL-2) station could only be computed at the end of that day, a procedure was developed to forecast the mean daily discharge for several days at a time. The procedure is described in the following example.

A section of the recession limb of the developed hydrograph for the period between June 24 and June 30 was selected. This section represented the general receding trend followed by the mean daily discharge (Figure 1). Regression analysis was used to fit a model that best described the decreasing trend of the hydrograph recession limb. A polynomial model was found to have the best fit for the dataset. The high coefficient of determination (R^2) indicates that the model described the data appropriately for prediction purposes (Table 1).

Table 1. Example of Regression Model Used to Predict Mean Daily Discharge Values at Doris Creek (TL-2)

Period of Data used to Build Model	Period Estimated	Model Equation	R^2
June 24 – June 30	July 1 – July 8	$y = 0.0014x^2 - 0.139x + 4.3814$	0.99

The developed model was then used to estimate mean daily discharges at Doris Creek (TL-2) for a period of time following the day the calculations were made. In the example above, the model developed on Saturday, June 30 was used to estimate mean daily discharges at Doris Creek (TL-2) for the period of Sunday, July 1 to Saturday, July 8.

Daily stage data retrieved remotely from station TL-2 were used to refine the developed regression model and to improve the fit of the model to the dataset. The regression model used to make predictions for the following week during periods in which the hydrograph changed gradually. However, when water levels showed more rapid changes (e.g., during the rapid rise caused by freshet), the regression model was revised every three days.

3. Results

Mean daily volumes were calculated from the predicted mean daily discharge values. The maximum allowable discharge from Tail Lake was calculated as 10% of the mean daily volume at Doris Creek (TL-2; Appendix A, Table A.1). The differences between the estimated and the recorded discharges at station TL-2 are provided in Appendix A, Table A.2.

When the regression model was revised, the estimated mean daily discharges and maximum allowable daily volumes were updated. When these values were updated the difference between the estimated and the recorded discharges at station TL-2 were also provided. These values were used to adjust the daily pumping rates from Tail Lake (Appendix A, Table A.2).

The maximum available volumes for Doris Creek TL-2 are shown in Figure 2. In comparison to the recorded data, the estimated values exceeded the maximum allowable discharge on 40 days between June 10 and September 13. On the days in which exceedance occurred, the average error of predicted values was 1.8% above the minimum allowable flow (range: 0.09 to 5.4%, or 3 to 146 m^3 above minimum allowable flow). However, the total predicted discharge volume for the period June 10-September 13 was under the maximum allowable 10% by 11,025 m^3 (Table 2).

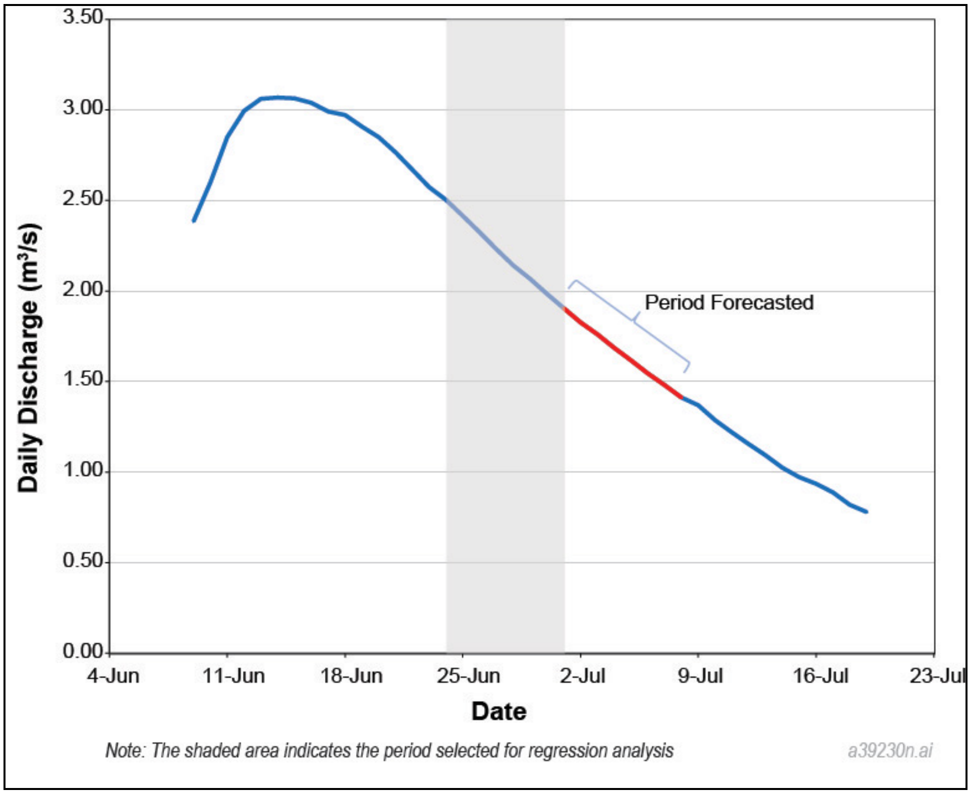

Figure 1. Example of Regression Model Development for Doris Creek (TL-2) Discharge Estimates

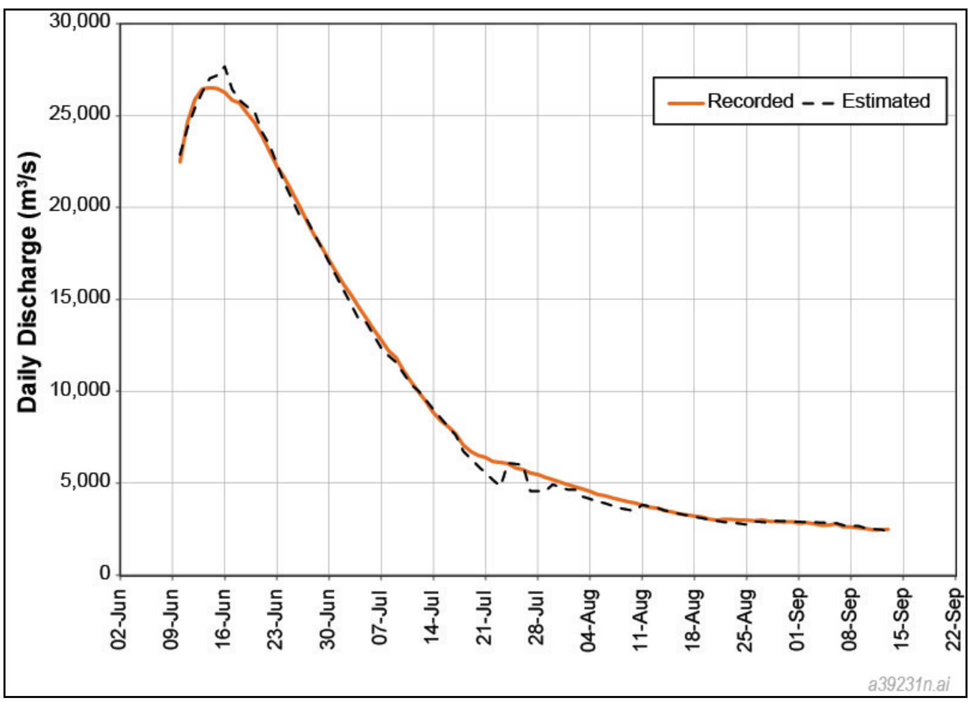

Figure 2. Maximum Allowable Discharge Volumes at Doris Creek (TL-2) June 10 - September 13, 2012

Table 2. Summary of Maximum Allowable Discharge Volumes at Doris Creek (TL-2) June 10 - September 13, 2012

Period of Record (days)	Days Exceeding 10% Allowable Discharge	Total Maximum Allowable Volume (m^3) from Estimated Values (June 10 - September 13)	Total Maximum Allowable Volume (m^3) from Recorded Values (June 10 - September 13)	Difference Recorded-Estimated (m^3)
96	40	902,266	913,291	11,025

In summary, the results show that the estimated maximum allowable discharges were generally conservative in estimating the daily water volumes at Doris Creek. For the period between June 10 and September 13, 2012 total discharge estimates were well below 10% of the total background flow recorded at the monitoring station TL-2 in Doris Creek.

References

Rescan. 2011. *Doris North Project: Hydrology Compliance Report 2011.* Prepared for Hope Bay Mining Ltd. by Rescan Environmental Services Ltd.: Vancouver, British Columbia.

Rescan. 2012. *Hope Bay Belt Project: Hydrology Baseline Report 2011.* Prepared for Hope Bay Mining Ltd. by Rescan Environmental Services Ltd.: Vancouver, British Columbia.

- Appendix A -

Discharge Volume Estimates for Doris Creek (Hydrometric Station Doris TL-2)

Table A.1. Estimated Mean Daily Discharge Values Based on Data Recorded at Doris TL-2, June 10 - September 13, 2012

Date	Mean Daily Discharge at TL-2 (m^3/s)	Maximum Allowable Discharge (10% of TL-2, m^3/s)	Daily Volume at TL-2 (m^3)	Maximum Allowable Discharge (10% of TL-2, m^3)
10-Jun-12	2.65	0.265	228,713	22,871
11-Jun-12	2.82	0.282	243,243	24,324
12-Jun-12	2.94	0.294	254,108	25,411
13-Jun-12	3.04	0.304	262,868	26,287
14-Jun-12	3.13	0.313	270,250	27,025
15-Jun-12	3.15	0.315	271,893	27,189
16-Jun-12	3.20	0.320	276,761	27,676
17-Jun-12	3.06	0.306	264,384	26,438
18-Jun-12	2.99	0.299	258,336	25,834
19-Jun-12	2.95	0.295	254,880	25,488
20-Jun-12	2.92	0.292	252,288	25,229
21-Jun-12	2.79	0.279	241,056	24,106
22-Jun-12	2.71	0.271	234,144	23,414
23-Jun-12	2.59	0.259	223,776	22,378
24-Jun-12	2.47	0.247	213,408	21,341
25-Jun-12	2.37	0.237	204,768	20,477
26-Jun-12	2.27	0.227	196,128	19,613
27-Jun-12	2.24	0.224	193,536	19,354
28-Jun-12	2.15	0.215	185,760	18,576
29-Jun-12	2.06	0.206	177,984	17,798
30-Jun-12	1.97	0.197	170,208	17,021
1-Jul-12	1.88	0.188	162,432	16,243
2-Jul-12	1.79	0.179	154,656	15,466
3-Jul-12	1.70	0.170	146,880	14,688
4-Jul-12	1.61	0.161	139,104	13,910
5-Jul-12	1.59	0.159	137,376	13,738
6-Jul-12	1.51	0.151	130,464	13,046
7-Jul-12	1.43	0.143	123,552	12,355
8-Jul-12	1.38	0.138	119,232	11,923
9-Jul-12	1.34	0.134	115,776	11,578
10-Jul-12	1.27	0.127	109,728	10,973
11-Jul-12	1.20	0.120	103,680	10,368
12-Jul-12	1.16	0.116	100,250	10,025
13-Jul-12	1.10	0.110	95,152	9,515
14-Jul-12	1.04	0.104	90,193	9,019
15-Jul-12	0.99	0.099	85,372	8,537
16-Jul-12	0.93	0.093	80,689	8,069
17-Jul-12	0.88	0.088	76,144	7,614
18-Jul-12	0.78	0.078	67,478	6,748
19-Jul-12	0.73	0.073	63,331	6,333
20-Jul-12	0.69	0.069	59,357	5,936
21-Jul-12	0.64	0.064	55,469	5,547

Table A.1. Estimated Mean Daily Discharge Values Based on Data Recorded at Doris TL-2, June 10 - September 13, 2012

Date	Mean Daily Discharge at TL-2 (m^3/s)	Maximum Allowable Discharge (10% of TL-2, m^3/s)	Daily Volume at TL-2 (m^3)	Maximum Allowable Discharge (10% of TL-2, m^3)
22-Jul-12	0.60	0.060	51,780	5,178
23-Jul-12	0.56	0.056	48,203	4,820
24-Jul-12	0.71	0.071	60,912	6,091
25-Jul-12	0.70	0.070	60,480	6,048
26-Jul-12	0.70	0.070	60,048	6,005
27-Jul-12	0.53	0.053	45,706	4,571
28-Jul-12	0.53	0.053	45,706	4,571
29-Jul-12	0.53	0.053	45,706	4,571
30-Jul-12	0.57	0.057	49,328	4,933
31-Jul-12	0.56	0.056	47,952	4,795
1-Aug-12	0.54	0.054	46,570	4,657
2-Aug-12	0.54	0.054	46,570	4,657
3-Aug-12	0.50	0.050	42,804	4,280
4-Aug-12	0.48	0.048	41,480	4,148
5-Aug-12	0.46	0.046	40,155	4,016
6-Aug-12	0.45	0.045	39,081	3,908
7-Aug-12	0.44	0.044	37,798	3,780
8-Aug-12	0.42	0.042	36,515	3,652
9-Aug-12	0.41	0.041	35,661	3,566
10-Aug-12	0.40	0.040	34,959	3,496
11-Aug-12	0.44	0.044	38,275	3,828
12-Aug-12	0.43	0.043	37,411	3,741
13-Aug-12	0.42	0.042	36,634	3,663
14-Aug-12	0.41	0.041	35,180	3,518
15-Aug-12	0.40	0.040	34,278	3,428
16-Aug-12	0.39	0.039	33,412	3,341
17-Aug-12	0.38	0.038	32,573	3,257
18-Aug-12	0.37	0.037	31,795	3,180
19-Aug-12	0.36	0.036	31,018	3,102
20-Aug-12	0.35	0.035	30,240	3,024
21-Aug-12	0.34	0.034	29,549	2,955
22-Aug-12	0.33	0.033	28,858	2,886
23-Aug-12	0.33	0.033	28,685	2,868
24-Aug-12	0.33	0.033	28,080	2,808
25-Aug-12	0.32	0.032	27,475	2,748
26-Aug-12	0.34	0.034	29,203	2,920
27-Aug-12	0.34	0.034	28,944	2,894
28-Aug-12	0.33	0.033	28,598	2,860
29-Aug-12	0.34	0.034	29,454	2,945
30-Aug-12	0.34	0.034	29,367	2,937
31-Aug-12	0.34	0.034	29,281	2,928
1-Sep-12	0.34	0.034	29,013	2,901

Table A.1. Estimated Mean Daily Discharge Values Based on Data Recorded at Doris TL-2, June 10 - September 13, 2012

Date	Mean Daily Discharge at TL-2 (m^3/s)	Maximum Allowable Discharge (10% of TL-2, m^3/s)	Daily Volume at TL-2 (m^3)	Maximum Allowable Discharge (10% of TL-2, m^3)
2-Sep-12	0.33	0.033	28,875	2,887
3-Sep-12	0.33	0.033	28,737	2,874
4-Sep-12	0.33	0.033	28,598	2,860
5-Sep-12	0.33	0.033	28,426	2,843
6-Sep-12	0.33	0.033	28,339	2,834
7-Sep-12	0.31	0.031	27,147	2,715
8-Sep-12	0.31	0.031	26,957	2,696
9-Sep-12	0.31	0.031	26,767	2,677
10-Sep-12	0.30	0.030	25,488	2,549
11-Sep-12	0.29	0.029	25,142	2,514
12-Sep-12	0.29	0.029	24,797	2,480
13-Sep-12	0.28	0.028	23,846	2,385

Table A.2. Comparison of Estimated Discharge and Recorded Discharge at Doris TL-2, June 10 - September 13, 2012

Date	Estimated Data Maximum Allowable Discharge (10% of TL-2, m^3)	Recorded Data Maximum Allowable Discharge (10% of TL-2, m^3)	Difference Recorded-Estimated (m^3)	Notes
10-Jun-12	22,871	22,466	-405	estimated volume over 10%
11-Jun-12	24,324	24,623	299	estimated volume under 10%
12-Jun-12	25,411	25,874	463	estimated volume under 10%
13-Jun-12	26,287	26,452	165	estimated volume under 10%
14-Jun-12	27,025	26,515	-510	estimated volume over 10%
15-Jun-12	27,189	26,470	-719	estimated volume over 10%
16-Jun-12	27,676	26,259	-1,418	estimated volume over 10%
17-Jun-12	26,438	25,840	-598	estimated volume over 10%
18-Jun-12	25,834	25,677	-157	estimated volume over 10%
19-Jun-12	25,488	25,126	-362	estimated volume over 10%
20-Jun-12	25,229	24,624	-605	estimated volume over 10%
21-Jun-12	24,106	23,899	-207	estimated volume over 10%
22-Jun-12	23,414	23,071	-344	estimated volume over 10%
23-Jun-12	22,378	22,237	-140	estimated volume over 10%
24-Jun-12	21,341	21,633	293	estimated volume under 10%
25-Jun-12	20,477	20,871	394	estimated volume under 10%
26-Jun-12	19,613	20,091	478	estimated volume under 10%
27-Jun-12	19,354	19,278	-76	estimated volume over 10%
28-Jun-12	18,576	18,499	-77	estimated volume over 10%
29-Jun-12	17,798	17,858	60	estimated volume under 10%
30-Jun-12	17,021	17,141	120	estimated volume under 10%
1-Jul-12	16,243	16,461	217	estimated volume under 10%
2-Jul-12	15,466	15,783	317	estimated volume under 10%
3-Jul-12	14,688	15,218	530	estimated volume under 10%
4-Jul-12	13,910	14,572	661	estimated volume under 10%
5-Jul-12	13,738	13,972	234	estimated volume under 10%
6-Jul-12	13,046	13,351	304	estimated volume under 10%
7-Jul-12	12,355	12,788	432	estimated volume under 10%
8-Jul-12	11,923	12,203	280	estimated volume under 10%
9-Jul-12	11,578	11,829	252	estimated volume under 10%
10-Jul-12	10,973	11,115	142	estimated volume under 10%
11-Jul-12	10,368	10,530	162	estimated volume under 10%
12-Jul-12	10,025	9,973	-52	estimated volume over 10%
13-Jul-12	9,515	9,439	-76	estimated volume over 10%
14-Jul-12	9,019	8,846	-174	estimated volume over 10%
15-Jul-12	8,537	8,399	-138	estimated volume over 10%
16-Jul-12	8,069	8,083	14	estimated volume under 10%
17-Jul-12	7,614	7,674	60	estimated volume under 10%
18-Jul-12	6,748	7,079	331	estimated volume under 10%
19-Jul-12	6,333	6,731	398	estimated volume under 10%
20-Jul-12	5,936	6,512	576	estimated volume under 10%
21-Jul-12	5,547	6,402	855	estimated volume under 10%

Table A.2. Comparison of Estimated Discharge and Recorded Discharge at Doris TL-2, June 10 - September 13, 2012

Date	Estimated Data Maximum Allowable Discharge (10% of TL-2, m^3)	Recorded Data Maximum Allowable Discharge (10% of TL-2, m^3)	Difference Recorded-Estimated (m^3)	Notes
22-Jul-12	5,178	6,181	1,003	estimated volume under 10%
23-Jul-12	4,820	6,133	1,313	estimated volume under 10%
24-Jul-12	6,091	6,068	-24	estimated volume over 10%
25-Jul-12	6,048	5,845	-203	estimated volume over 10%
26-Jul-12	6,005	5,737	-267	estimated volume over 10%
27-Jul-12	4,571	5,555	984	estimated volume under 10%
28-Jul-12	4,571	5,481	911	estimated volume under 10%
29-Jul-12	4,571	5,324	754	estimated volume under 10%
30-Jul-12	4,933	5,195	262	estimated volume under 10%
31-Jul-12	4,795	5,061	266	estimated volume under 10%
1-Aug-12	4,657	4,927	270	estimated volume under 10%
2-Aug-12	4,657	4,800	143	estimated volume under 10%
3-Aug-12	4,280	4,686	406	estimated volume under 10%
4-Aug-12	4,148	4,555	407	estimated volume under 10%
5-Aug-12	4,016	4,394	378	estimated volume under 10%
6-Aug-12	3,908	4,320	412	estimated volume under 10%
7-Aug-12	3,780	4,203	423	estimated volume under 10%
8-Aug-12	3,652	4,104	452	estimated volume under 10%
9-Aug-12	3,566	4,000	434	estimated volume under 10%
10-Aug-12	3,496	3,935	439	estimated volume under 10%
11-Aug-12	3,828	3,810	-17	estimated volume over 10%
12-Aug-12	3,741	3,698	-43	estimated volume over 10%
13-Aug-12	3,663	3,649	-14	estimated volume over 10%
14-Aug-12	3,518	3,515	-3	estimated volume over 10%
15-Aug-12	3,428	3,438	10	estimated volume under 10%
16-Aug-12	3,341	3,332	-9	estimated volume over 10%
17-Aug-12	3,257	3,272	15	estimated volume under 10%
18-Aug-12	3,180	3,213	34	estimated volume under 10%
19-Aug-12	3,102	3,170	68	estimated volume under 10%
20-Aug-12	3,024	3,053	29	estimated volume under 10%
21-Aug-12	2,955	2,997	42	estimated volume under 10%
22-Aug-12	2,886	3,043	157	estimated volume under 10%
23-Aug-12	2,868	3,030	162	estimated volume under 10%
24-Aug-12	2,808	3,001	193	estimated volume under 10%
25-Aug-12	2,748	2,994	247	estimated volume under 10%
26-Aug-12	2,920	2,956	36	estimated volume under 10%
27-Aug-12	2,894	3,005	111	estimated volume under 10%
28-Aug-12	2,860	2,932	73	estimated volume under 10%
29-Aug-12	2,945	2,913	-33	estimated volume over 10%
30-Aug-12	2,937	2,897	-40	estimated volume over 10%
31-Aug-12	2,928	2,916	-13	estimated volume over 10%
1-Sep-12	2,901	2,828	-73	estimated volume over 10%

Table A.2. Comparison of Estimated Discharge and Recorded Discharge at Doris TL-2, June 10 - September 13, 2012

Date	Estimated Data Maximum Allowable Discharge (10% of TL-2, m^3)	Recorded Data Maximum Allowable Discharge (10% of TL-2, m^3)	Difference Recorded-Estimated (m^3)	Notes
2-Sep-12	2,887	2,860	-28	estimated volume over 10%
3-Sep-12	2,874	2,800	-73	estimated volume over 10%
4-Sep-12	2,860	2,714	-146	estimated volume over 10%
5-Sep-12	2,843	2,721	-122	estimated volume over 10%
6-Sep-12	2,834	2,792	-42	estimated volume over 10%
7-Sep-12	2,715	2,621	-94	estimated volume over 10%
8-Sep-12	2,696	2,618	-77	estimated volume over 10%
9-Sep-12	2,677	2,573	-103	estimated volume over 10%
10-Sep-12	2,549	2,529	-20	estimated volume over 10%
11-Sep-12	2,514	2,464	-51	estimated volume over 10%
12-Sep-12	2,480	2,475	-4	estimated volume over 10%
13-Sep-12	2,385	2,495	111	estimated volume under 10%

Appendix E

2012 Mean Daily Discharges at Hydrometric Monitoring Stations in the Doris North Project Area

Rescan™
Engineers and Scientists

Appendix E-1. Summary of Daily Mean Discharge [Q] at Doris TL-2 in 2012

Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)
1-Jan	*0.000*	2-Mar	*0.000*	2-May	*0.000*	2-Jul	2.153	1-Sep	0.205	1-Nov	*0.000*
2-Jan	*0.000*	3-Mar	*0.000*	3-May	*0.000*	3-Jul	2.022	2-Sep	0.212	2-Nov	*0.000*
3-Jan	*0.000*	4-Mar	*0.000*	4-May	*0.000*	4-Jul	1.873	3-Sep	0.200	3-Nov	*0.000*
4-Jan	*0.000*	5-Mar	*0.000*	5-May	*0.000*	5-Jul	1.735	4-Sep	0.183	4-Nov	*0.000*
5-Jan	*0.000*	6-Mar	*0.000*	6-May	*0.000*	6-Jul	1.591	5-Sep	0.185	5-Nov	*0.000*
6-Jan	*0.000*	7-Mar	*0.000*	7-May	*0.000*	7-Jul	1.462	6-Sep	0.199	6-Nov	*0.000*
7-Jan	*0.000*	8-Mar	*0.000*	8-May	*0.000*	8-Jul	1.330	7-Sep	0.166	7-Nov	*0.000*
8-Jan	*0.000*	9-Mar	*0.000*	9-May	*0.000*	9-Jul	1.246	8-Sep	0.165	8-Nov	*0.000*
9-Jan	*0.000*	10-Mar	*0.000*	10-May	*0.000*	10-Jul	1.086	9-Sep	0.157	9-Nov	*0.000*
10-Jan	*0.000*	11-Mar	*0.000*	11-May	*0.000*	11-Jul	0.973	10-Sep	0.149	10-Nov	*0.000*
11-Jan	*0.000*	12-Mar	*0.000*	12-May	*0.000*	12-Jul	0.927	11-Sep	0.138	11-Nov	*0.000*
12-Jan	*0.000*	13-Mar	*0.000*	13-May	*0.000*	13-Jul	0.897	12-Sep	0.138	12-Nov	*0.000*
13-Jan	*0.000*	14-Mar	*0.000*	14-May	*0.000*	14-Jul	0.863	13-Sep	0.143	13-Nov	*0.000*
14-Jan	*0.000*	15-Mar	*0.000*	15-May	*0.000*	15-Jul	0.836	14-Sep	*0.135*	14-Nov	*0.000*
15-Jan	*0.000*	16-Mar	*0.000*	16-May	*0.000*	16-Jul	0.817	15-Sep	*0.131*	15-Nov	*0.000*
16-Jan	*0.000*	17-Mar	*0.000*	17-May	*0.000*	17-Jul	0.792	16-Sep	*0.127*	16-Nov	*0.000*
17-Jan	*0.000*	18-Mar	*0.000*	18-May	*0.000*	18-Jul	0.754	17-Sep	*0.123*	17-Nov	*0.000*
18-Jan	*0.000*	19-Mar	*0.000*	19-May	*0.000*	19-Jul	0.720	18-Sep	*0.119*	18-Nov	*0.000*
19-Jan	*0.000*	20-Mar	*0.000*	20-May	*0.000*	20-Jul	0.692	19-Sep	*0.114*	19-Nov	*0.000*
20-Jan	*0.000*	21-Mar	*0.000*	21-May	*0.000*	21-Jul	0.677	20-Sep	*0.110*	20-Nov	*0.000*
21-Jan	*0.000*	22-Mar	*0.000*	22-May	*0.000*	22-Jul	0.649	21-Sep	*0.106*	21-Nov	*0.000*
22-Jan	*0.000*	23-Mar	*0.000*	23-May	*0.000*	23-Jul	0.643	22-Sep	*0.102*	22-Nov	*0.000*
23-Jan	*0.000*	24-Mar	*0.000*	24-May	*0.000*	24-Jul	0.634	23-Sep	*0.098*	23-Nov	*0.000*
24-Jan	*0.000*	25-Mar	*0.000*	25-May	*0.000*	25-Jul	0.606	24-Sep	*0.093*	24-Nov	*0.000*
25-Jan	*0.000*	26-Mar	*0.000*	26-May	*0.000*	26-Jul	0.592	25-Sep	*0.089*	25-Nov	*0.000*
26-Jan	*0.000*	27-Mar	*0.000*	27-May	*0.000*	27-Jul	0.569	26-Sep	*0.085*	26-Nov	*0.000*
27-Jan	*0.000*	28-Mar	*0.000*	28-May	*0.000*	28-Jul	0.559	27-Sep	*0.081*	27-Nov	*0.000*
28-Jan	*0.000*	29-Mar	*0.000*	29-May	*0.000*	29-Jul	0.540	28-Sep	*0.077*	28-Nov	*0.000*
29-Jan	*0.000*	30-Mar	*0.000*	30-May	*0.000*	30-Jul	0.524	29-Sep	*0.072*	29-Nov	*0.000*
30-Jan	*0.000*	31-Mar	*0.000*	31-May	*0.000*	31-Jul	0.507	30-Sep	*0.068*	30-Nov	*0.000*
31-Jan	*0.000*	1-Apr	*0.000*	1-Jun	*0.000*	1-Aug	0.490	1-Oct	*0.064*	1-Dec	*0.000*
1-Feb	*0.000*	2-Apr	*0.000*	2-Jun	*0.000*	2-Aug	0.475	2-Oct	*0.060*	2-Dec	*0.000*
2-Feb	*0.000*	3-Apr	*0.000*	3-Jun	*0.000*	3-Aug	0.461	3-Oct	*0.056*	3-Dec	*0.000*
3-Feb	*0.000*	4-Apr	*0.000*	4-Jun	*0.000*	4-Aug	0.445	4-Oct	*0.051*	4-Dec	*0.000*
4-Feb	*0.000*	5-Apr	*0.000*	5-Jun	*0.001*	5-Aug	0.425	5-Oct	*0.047*	5-Dec	*0.000*
5-Feb	*0.000*	6-Apr	*0.000*	6-Jun	*0.005*	6-Aug	0.416	6-Oct	*0.043*	6-Dec	*0.000*
6-Feb	*0.000*	7-Apr	*0.000*	7-Jun	*0.040*	7-Aug	0.402	7-Oct	*0.039*	7-Dec	*0.000*
7-Feb	*0.000*	8-Apr	*0.000*	8-Jun	*0.341*	8-Aug	0.390	8-Oct	*0.035*	8-Dec	*0.000*
8-Feb	*0.000*	9-Apr	*0.000*	9-Jun	2.919	9-Aug	0.378	9-Oct	*0.030*	9-Dec	*0.000*
9-Feb	*0.000*	10-Apr	*0.000*	10-Jun	3.127	10-Aug	0.370	10-Oct	*0.026*	10-Dec	*0.000*
10-Feb	*0.000*	11-Apr	*0.000*	11-Jun	3.362	11-Aug	0.356	11-Oct	*0.022*	11-Dec	*0.000*
11-Feb	*0.000*	12-Apr	*0.000*	12-Jun	3.495	12-Aug	0.343	12-Oct	*0.018*	12-Dec	*0.000*
12-Feb	*0.000*	13-Apr	*0.000*	13-Jun	3.556	13-Aug	0.337	13-Oct	*0.014*	13-Dec	*0.000*
13-Feb	*0.000*	14-Apr	*0.000*	14-Jun	3.562	14-Aug	0.321	14-Oct	*0.009*	14-Dec	*0.000*
14-Feb	*0.000*	15-Apr	*0.000*	15-Jun	3.557	15-Aug	0.312	15-Oct	*0.005*	15-Dec	*0.000*
15-Feb	*0.000*	16-Apr	*0.000*	16-Jun	3.528	16-Aug	0.300	16-Oct	*0.001*	16-Dec	*0.000*
16-Feb	*0.000*	17-Apr	*0.000*	17-Jun	3.491	17-Aug	0.291	17-Oct	*0.000*	17-Dec	*0.000*
17-Feb	*0.000*	18-Apr	*0.000*	18-Jun	3.474	18-Aug	0.282	18-Oct	*0.000*	18-Dec	*0.000*
18-Feb	*0.000*	19-Apr	*0.000*	19-Jun	3.415	19-Aug	0.275	19-Oct	*0.000*	19-Dec	*0.000*
19-Feb	*0.000*	20-Apr	*0.000*	20-Jun	3.362	20-Aug	0.253	20-Oct	*0.000*	20-Dec	*0.000*
20-Feb	*0.000*	21-Apr	*0.000*	21-Jun	3.284	21-Aug	0.241	21-Oct	*0.000*	21-Dec	*0.000*
21-Feb	*0.000*	22-Apr	*0.000*	22-Jun	3.193	22-Aug	0.251	22-Oct	*0.000*	22-Dec	*0.000*
22-Feb	*0.000*	23-Apr	*0.000*	23-Jun	3.101	23-Aug	0.248	23-Oct	*0.000*	23-Dec	*0.000*
23-Feb	*0.000*	24-Apr	*0.000*	24-Jun	3.036	24-Aug	0.242	24-Oct	*0.000*	24-Dec	*0.000*
24-Feb	*0.000*	25-Apr	*0.000*	25-Jun	2.947	25-Aug	0.241	25-Oct	*0.000*	25-Dec	*0.000*
25-Feb	*0.000*	26-Apr	*0.000*	26-Jun	2.857	26-Aug	0.232	26-Oct	*0.000*	26-Dec	*0.000*
26-Feb	*0.000*	27-Apr	*0.000*	27-Jun	2.762	27-Aug	0.243	27-Oct	*0.000*	27-Dec	*0.000*
27-Feb	*0.000*	28-Apr	*0.000*	28-Jun	2.670	28-Aug	0.227	28-Oct	*0.000*	28-Dec	*0.000*
28-Feb	*0.000*	29-Apr	*0.000*	29-Jun	2.593	29-Aug	0.223	29-Oct	*0.000*	29-Dec	*0.000*
29-Feb	*0.000*	30-Apr	*0.000*	30-Jun	2.490	30-Aug	0.220	30-Oct	*0.000*	30-Dec	*0.000*
1-Mar	*0.000*	1-May	*0.000*	1-Jul	2.309	31-Aug	0.224	31-Oct	*0.000*	31-Dec	*0.000*

Note: Estimated values are italicized

Appendix E-2. Summary of Daily Mean Discharge [Q] at Doris TL-3 in 2012

Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)
1-Jan	*0.000*	2-Mar	*0.000*	2-May	*0.000*	2-Jul	1.992	1-Sep	0.222	1-Nov	*0.000*
2-Jan	*0.000*	3-Mar	*0.000*	3-May	*0.000*	3-Jul	1.852	2-Sep	0.201	2-Nov	*0.000*
3-Jan	*0.000*	4-Mar	*0.000*	4-May	*0.000*	4-Jul	1.725	3-Sep	0.208	3-Nov	*0.000*
4-Jan	*0.000*	5-Mar	*0.000*	5-May	*0.000*	5-Jul	1.607	4-Sep	0.195	4-Nov	*0.000*
5-Jan	*0.000*	6-Mar	*0.000*	6-May	*0.000*	6-Jul	1.504	5-Sep	0.205	5-Nov	*0.000*
6-Jan	*0.000*	7-Mar	*0.000*	7-May	*0.000*	7-Jul	1.396	6-Sep	0.221	6-Nov	*0.000*
7-Jan	*0.000*	8-Mar	*0.000*	8-May	*0.000*	8-Jul	1.325	7-Sep	0.237	7-Nov	*0.000*
8-Jan	*0.000*	9-Mar	*0.000*	9-May	*0.000*	9-Jul	1.251	8-Sep	0.188	8-Nov	*0.000*
9-Jan	*0.000*	10-Mar	*0.000*	10-May	*0.000*	10-Jul	1.212	9-Sep	0.190	9-Nov	*0.000*
10-Jan	*0.000*	11-Mar	*0.000*	11-May	*0.000*	11-Jul	1.139	10-Sep	0.179	10-Nov	*0.000*
11-Jan	*0.000*	12-Mar	*0.000*	12-May	*0.000*	12-Jul	1.103	11-Sep	0.174	11-Nov	*0.000*
12-Jan	*0.000*	13-Mar	*0.000*	13-May	*0.000*	13-Jul	1.076	12-Sep	*0.163*	12-Nov	*0.000*
13-Jan	*0.000*	14-Mar	*0.000*	14-May	*0.000*	14-Jul	1.049	13-Sep	*0.158*	13-Nov	*0.000*
14-Jan	*0.000*	15-Mar	*0.000*	15-May	*0.000*	15-Jul	1.021	14-Sep	*0.153*	14-Nov	0.000
15-Jan	*0.000*	16-Mar	*0.000*	16-May	*0.000*	16-Jul	1.001	15-Sep	*0.148*	15-Nov	0.000
16-Jan	*0.000*	17-Mar	*0.000*	17-May	*0.000*	17-Jul	0.974	16-Sep	*0.143*	16-Nov	0.000
17-Jan	*0.000*	18-Mar	*0.000*	18-May	*0.000*	18-Jul	0.951	17-Sep	*0.138*	17-Nov	0.000
18-Jan	*0.000*	19-Mar	*0.000*	19-May	*0.000*	19-Jul	0.910	18-Sep	*0.133*	18-Nov	0.000
19-Jan	*0.000*	20-Mar	*0.000*	20-May	*0.000*	20-Jul	0.880	19-Sep	*0.128*	19-Nov	0.000
20-Jan	*0.000*	21-Mar	*0.000*	21-May	*0.000*	21-Jul	0.848	20-Sep	*0.124*	20-Nov	*0.000*
21-Jan	*0.000*	22-Mar	*0.000*	22-May	*0.000*	22-Jul	0.833	21-Sep	*0.119*	21-Nov	*0.000*
22-Jan	*0.000*	23-Mar	*0.000*	23-May	*0.000*	23-Jul	0.810	22-Sep	*0.114*	22-Nov	*0.000*
23-Jan	*0.000*	24-Mar	*0.000*	24-May	*0.000*	24-Jul	0.781	23-Sep	*0.109*	23-Nov	*0.000*
24-Jan	*0.000*	25-Mar	*0.000*	25-May	*0.000*	25-Jul	0.763	24-Sep	*0.104*	24-Nov	*0.000*
25-Jan	*0.000*	26-Mar	*0.000*	26-May	*0.000*	26-Jul	0.731	25-Sep	*0.099*	25-Nov	*0.000*
26-Jan	*0.000*	27-Mar	*0.000*	27-May	*0.000*	27-Jul	0.732	26-Sep	*0.094*	26-Nov	*0.000*
27-Jan	*0.000*	28-Mar	*0.000*	28-May	*0.000*	28-Jul	0.734	27-Sep	*0.089*	27-Nov	*0.000*
28-Jan	*0.000*	29-Mar	*0.000*	29-May	*0.000*	29-Jul	0.719	28-Sep	*0.084*	28-Nov	*0.000*
29-Jan	*0.000*	30-Mar	*0.000*	30-May	*0.000*	30-Jul	0.700	29-Sep	*0.079*	29-Nov	*0.000*
30-Jan	*0.000*	31-Mar	*0.000*	31-May	*0.000*	31-Jul	0.688	30-Sep	*0.075*	30-Nov	*0.000*
31-Jan	*0.000*	1-Apr	*0.000*	1-Jun	*0.000*	1-Aug	0.669	1-Oct	*0.070*	1-Dec	*0.000*
1-Feb	*0.000*	2-Apr	*0.000*	2-Jun	*0.000*	2-Aug	0.650	2-Oct	*0.065*	2-Dec	0.000
2-Feb	*0.000*	3-Apr	*0.000*	3-Jun	*0.000*	3-Aug	0.633	3-Oct	*0.060*	3-Dec	*0.000*
3-Feb	*0.000*	4-Apr	*0.000*	4-Jun	*0.000*	4-Aug	0.615	4-Oct	*0.055*	4-Dec	*0.000*
4-Feb	*0.000*	5-Apr	*0.000*	5-Jun	*0.000*	5-Aug	0.595	5-Oct	*0.050*	5-Dec	*0.000*
5-Feb	*0.000*	6-Apr	*0.000*	6-Jun	*0.001*	6-Aug	0.574	6-Oct	*0.045*	6-Dec	*0.000*
6-Feb	*0.000*	7-Apr	*0.000*	7-Jun	*0.003*	7-Aug	0.567	7-Oct	*0.040*	7-Dec	*0.000*
7-Feb	*0.000*	8-Apr	*0.000*	8-Jun	*0.019*	8-Aug	0.553	8-Oct	*0.035*	8-Dec	*0.000*
8-Feb	*0.000*	9-Apr	*0.000*	9-Jun	*0.106*	9-Aug	0.536	9-Oct	*0.030*	9-Dec	*0.000*
9-Feb	*0.000*	10-Apr	*0.000*	10-Jun	*0.600*	10-Aug	0.491	10-Oct	*0.026*	10-Dec	*0.000*
10-Feb	*0.000*	11-Apr	*0.000*	11-Jun	3.401	11-Aug	0.492	11-Oct	*0.021*	11-Dec	*0.000*
11-Feb	*0.000*	12-Apr	*0.000*	12-Jun	3.619	12-Aug	0.449	12-Oct	*0.016*	12-Dec	*0.000*
12-Feb	*0.000*	13-Apr	*0.000*	13-Jun	3.746	13-Aug	0.440	13-Oct	*0.011*	13-Dec	*0.000*
13-Feb	*0.000*	14-Apr	*0.000*	14-Jun	3.780	14-Aug	0.430	14-Oct	*0.006*	14-Dec	*0.000*
14-Feb	*0.000*	15-Apr	*0.000*	15-Jun	3.763	15-Aug	0.392	15-Oct	*0.001*	15-Dec	*0.000*
15-Feb	*0.000*	16-Apr	*0.000*	16-Jun	3.744	16-Aug	0.370	16-Oct	*0.000*	16-Dec	*0.000*
16-Feb	*0.000*	17-Apr	*0.000*	17-Jun	3.767	17-Aug	0.339	17-Oct	*0.000*	17-Dec	*0.000*
17-Feb	*0.000*	18-Apr	*0.000*	18-Jun	3.736	18-Aug	0.324	18-Oct	*0.000*	18-Dec	*0.000*
18-Feb	*0.000*	19-Apr	*0.000*	19-Jun	3.678	19-Aug	0.312	19-Oct	*0.000*	19-Dec	*0.000*
19-Feb	*0.000*	20-Apr	*0.000*	20-Jun	3.567	20-Aug	0.304	20-Oct	*0.000*	20-Dec	*0.000*
20-Feb	*0.000*	21-Apr	*0.000*	21-Jun	3.513	21-Aug	0.271	21-Oct	*0.000*	21-Dec	*0.000*
21-Feb	*0.000*	22-Apr	*0.000*	22-Jun	3.408	22-Aug	0.257	22-Oct	*0.000*	22-Dec	*0.000*
22-Feb	*0.000*	23-Apr	*0.000*	23-Jun	3.292	23-Aug	0.271	23-Oct	*0.000*	23-Dec	*0.000*
23-Feb	*0.000*	24-Apr	*0.000*	24-Jun	3.182	24-Aug	0.268	24-Oct	*0.000*	24-Dec	*0.000*
24-Feb	*0.000*	25-Apr	*0.000*	25-Jun	3.057	25-Aug	0.262	25-Oct	*0.000*	25-Dec	*0.000*
25-Feb	*0.000*	26-Apr	*0.000*	26-Jun	2.941	26-Aug	0.254	26-Oct	*0.000*	26-Dec	*0.000*
26-Feb	*0.000*	27-Apr	*0.000*	27-Jun	2.788	27-Aug	0.241	27-Oct	*0.000*	27-Dec	*0.000*
27-Feb	*0.000*	28-Apr	*0.000*	28-Jun	2.632	28-Aug	0.242	28-Oct	*0.000*	28-Dec	*0.000*
28-Feb	*0.000*	29-Apr	*0.000*	29-Jun	2.463	29-Aug	0.224	29-Oct	*0.000*	29-Dec	*0.000*
29-Feb	*0.000*	30-Apr	*0.000*	30-Jun	2.295	30-Aug	0.221	30-Oct	*0.000*	30-Dec	*0.000*
1-Mar	*0.000*	1-May	*0.000*	1-Jul	2.130	31-Aug	0.217	31-Oct	*0.000*	31-Dec	*0.000*

Note: Estimated values are italicized

Appendix E-3. Summary of Daily Mean Discharge [Q] at Roberts Hydro in 2012

Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)
1-Jan	*0.000*	2-Mar	*0.000*	2-May	*0.000*	2-Jul	2.065	1-Sep	0.155	1-Nov	*0.000*
2-Jan	*0.000*	3-Mar	*0.000*	3-May	*0.000*	3-Jul	1.963	2-Sep	0.148	2-Nov	*0.000*
3-Jan	*0.000*	4-Mar	*0.000*	4-May	*0.000*	4-Jul	1.861	3-Sep	0.148	3-Nov	*0.000*
4-Jan	*0.000*	5-Mar	*0.000*	5-May	*0.000*	5-Jul	1.757	4-Sep	0.142	4-Nov	*0.000*
5-Jan	*0.000*	6-Mar	*0.000*	6-May	*0.000*	6-Jul	1.654	5-Sep	0.142	5-Nov	*0.000*
6-Jan	*0.000*	7-Mar	*0.000*	7-May	*0.000*	7-Jul	1.565	6-Sep	0.140	6-Nov	*0.000*
7-Jan	*0.000*	8-Mar	*0.000*	8-May	*0.000*	8-Jul	1.482	7-Sep	0.133	7-Nov	*0.000*
8-Jan	*0.000*	9-Mar	*0.000*	9-May	*0.000*	9-Jul	1.405	8-Sep	0.123	8-Nov	*0.000*
9-Jan	*0.000*	10-Mar	*0.000*	10-May	*0.000*	10-Jul	1.337	9-Sep	0.122	9-Nov	*0.000*
10-Jan	*0.000*	11-Mar	*0.000*	11-May	*0.000*	11-Jul	1.251	10-Sep	0.115	10-Nov	*0.000*
11-Jan	*0.000*	12-Mar	*0.000*	12-May	*0.000*	12-Jul	1.195	11-Sep	0.111	11-Nov	*0.000*
12-Jan	*0.000*	13-Mar	*0.000*	13-May	*0.000*	13-Jul	1.126	12-Sep	0.107	12-Nov	*0.000*
13-Jan	*0.000*	14-Mar	*0.000*	14-May	*0.000*	14-Jul	1.065	13-Sep	*0.094*	13-Nov	*0.000*
14-Jan	*0.000*	15-Mar	*0.000*	15-May	*0.000*	15-Jul	0.997	14-Sep	*0.090*	14-Nov	*0.000*
15-Jan	*0.000*	16-Mar	*0.000*	16-May	*0.000*	16-Jul	0.953	15-Sep	*0.086*	15-Nov	*0.000*
16-Jan	*0.000*	17-Mar	*0.000*	17-May	*0.000*	17-Jul	0.913	16-Sep	*0.082*	16-Nov	*0.000*
17-Jan	*0.000*	18-Mar	*0.000*	18-May	*0.000*	18-Jul	0.884	17-Sep	*0.078*	17-Nov	*0.000*
18-Jan	*0.000*	19-Mar	*0.000*	19-May	*0.000*	19-Jul	0.824	18-Sep	*0.074*	18-Nov	*0.000*
19-Jan	*0.000*	20-Mar	*0.000*	20-May	*0.000*	20-Jul	0.781	19-Sep	*0.070*	19-Nov	*0.000*
20-Jan	*0.000*	21-Mar	*0.000*	21-May	*0.000*	21-Jul	0.754	20-Sep	*0.066*	20-Nov	*0.000*
21-Jan	*0.000*	22-Mar	*0.000*	22-May	*0.000*	22-Jul	0.728	21-Sep	*0.062*	21-Nov	*0.000*
22-Jan	*0.000*	23-Mar	*0.000*	23-May	*0.000*	23-Jul	0.679	22-Sep	*0.058*	22-Nov	*0.000*
23-Jan	*0.000*	24-Mar	*0.000*	24-May	*0.000*	24-Jul	0.636	23-Sep	*0.054*	23-Nov	*0.000*
24-Jan	*0.000*	25-Mar	*0.000*	25-May	*0.000*	25-Jul	0.622	24-Sep	*0.050*	24-Nov	*0.000*
25-Jan	*0.000*	26-Mar	*0.000*	26-May	*0.000*	26-Jul	0.594	25-Sep	*0.046*	25-Nov	*0.000*
26-Jan	*0.000*	27-Mar	*0.000*	27-May	*0.000*	27-Jul	0.585	26-Sep	*0.042*	26-Nov	*0.000*
27-Jan	*0.000*	28-Mar	*0.000*	28-May	*0.000*	28-Jul	0.548	27-Sep	*0.038*	27-Nov	*0.000*
28-Jan	*0.000*	29-Mar	*0.000*	29-May	*0.000*	29-Jul	0.525	28-Sep	*0.034*	28-Nov	*0.000*
29-Jan	*0.000*	30-Mar	*0.000*	30-May	*0.000*	30-Jul	0.501	29-Sep	*0.030*	29-Nov	*0.000*
30-Jan	*0.000*	31-Mar	*0.000*	31-May	*0.000*	31-Jul	0.482	30-Sep	*0.026*	30-Nov	*0.000*
31-Jan	*0.000*	1-Apr	*0.000*	1-Jun	*0.000*	1-Aug	0.460	1-Oct	*0.022*	1-Dec	*0.000*
1-Feb	*0.000*	2-Apr	*0.000*	2-Jun	*0.000*	2-Aug	0.439	2-Oct	*0.018*	2-Dec	*0.000*
2-Feb	*0.000*	3-Apr	*0.000*	3-Jun	*0.000*	3-Aug	0.423	3-Oct	*0.014*	3-Dec	*0.000*
3-Feb	*0.000*	4-Apr	*0.000*	4-Jun	*0.000*	4-Aug	0.404	4-Oct	*0.010*	4-Dec	*0.000*
4-Feb	*0.000*	5-Apr	*0.000*	5-Jun	*0.000*	5-Aug	0.396	5-Oct	*0.006*	5-Dec	*0.000*
5-Feb	*0.000*	6-Apr	*0.000*	6-Jun	*0.001*	6-Aug	0.363	6-Oct	*0.002*	6-Dec	*0.000*
6-Feb	*0.000*	7-Apr	*0.000*	7-Jun	*0.010*	7-Aug	0.347	7-Oct	*0.000*	7-Dec	*0.000*
7-Feb	*0.000*	8-Apr	*0.000*	8-Jun	*0.069*	8-Aug	0.332	8-Oct	*0.000*	8-Dec	*0.000*
8-Feb	*0.000*	9-Apr	*0.000*	9-Jun	*0.468*	9-Aug	0.322	9-Oct	*0.000*	9-Dec	*0.000*
9-Feb	*0.000*	10-Apr	*0.000*	10-Jun	3.191	10-Aug	0.316	10-Oct	*0.000*	10-Dec	*0.000*
10-Feb	*0.000*	11-Apr	*0.000*	11-Jun	3.295	11-Aug	0.304	11-Oct	*0.000*	11-Dec	*0.000*
11-Feb	*0.000*	12-Apr	*0.000*	12-Jun	3.419	12-Aug	0.281	12-Oct	*0.000*	12-Dec	*0.000*
12-Feb	*0.000*	13-Apr	*0.000*	13-Jun	3.499	13-Aug	0.266	13-Oct	*0.000*	13-Dec	*0.000*
13-Feb	*0.000*	14-Apr	*0.000*	14-Jun	3.503	14-Aug	0.256	14-Oct	*0.000*	14-Dec	*0.000*
14-Feb	*0.000*	15-Apr	*0.000*	15-Jun	3.490	15-Aug	0.239	15-Oct	*0.000*	15-Dec	*0.000*
15-Feb	*0.000*	16-Apr	*0.000*	16-Jun	3.472	16-Aug	0.227	16-Oct	*0.000*	16-Dec	*0.000*
16-Feb	*0.000*	17-Apr	*0.000*	17-Jun	3.472	17-Aug	0.214	17-Oct	*0.000*	17-Dec	*0.000*
17-Feb	*0.000*	18-Apr	*0.000*	18-Jun	3.550	18-Aug	0.206	18-Oct	*0.000*	18-Dec	*0.000*
18-Feb	*0.000*	19-Apr	*0.000*	19-Jun	3.604	19-Aug	0.199	19-Oct	*0.000*	19-Dec	*0.000*
19-Feb	*0.000*	20-Apr	*0.000*	20-Jun	3.575	20-Aug	0.183	20-Oct	*0.000*	20-Dec	*0.000*
20-Feb	*0.000*	21-Apr	*0.000*	21-Jun	3.513	21-Aug	0.170	21-Oct	*0.000*	21-Dec	*0.000*
21-Feb	*0.000*	22-Apr	*0.000*	22-Jun	3.409	22-Aug	0.168	22-Oct	*0.000*	22-Dec	*0.000*
22-Feb	*0.000*	23-Apr	*0.000*	23-Jun	3.275	23-Aug	0.174	23-Oct	*0.000*	23-Dec	*0.000*
23-Feb	*0.000*	24-Apr	*0.000*	24-Jun	3.143	24-Aug	0.173	24-Oct	*0.000*	24-Dec	*0.000*
24-Feb	*0.000*	25-Apr	*0.000*	25-Jun	3.020	25-Aug	0.170	25-Oct	*0.000*	25-Dec	*0.000*
25-Feb	*0.000*	26-Apr	*0.000*	26-Jun	2.887	26-Aug	0.166	26-Oct	*0.000*	26-Dec	*0.000*
26-Feb	*0.000*	27-Apr	*0.000*	27-Jun	2.742	27-Aug	0.161	27-Oct	*0.000*	27-Dec	*0.000*
27-Feb	*0.000*	28-Apr	*0.000*	28-Jun	2.586	28-Aug	0.160	28-Oct	*0.000*	28-Dec	*0.000*
28-Feb	*0.000*	29-Apr	*0.000*	29-Jun	2.453	29-Aug	0.160	29-Oct	*0.000*	29-Dec	*0.000*
29-Feb	*0.000*	30-Apr	*0.000*	30-Jun	2.315	30-Aug	0.161	30-Oct	*0.000*	30-Dec	*0.000*
1-Mar	*0.000*	1-May	*0.000*	1-Jul	2.184	31-Aug	0.158	31-Oct	*0.000*	31-Dec	*0.000*

Note: Estimated values are italicized

Appendix E-4. Summary of Daily Mean Discharge [Q] at Windy Hydro in 2012

Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)
1-Jan	*0.000*	2-Mar	*0.000*	2-May	*0.000*	2-Jul	0.303	1-Sep	0.082	1-Nov	*0.000*
2-Jan	*0.000*	3-Mar	*0.000*	3-May	*0.000*	3-Jul	0.295	2-Sep	0.079	2-Nov	*0.000*
3-Jan	*0.000*	4-Mar	*0.000*	4-May	*0.000*	4-Jul	0.287	3-Sep	0.080	3-Nov	*0.000*
4-Jan	*0.000*	5-Mar	*0.000*	5-May	*0.000*	5-Jul	0.277	4-Sep	0.077	4-Nov	*0.000*
5-Jan	*0.000*	6-Mar	*0.000*	6-May	*0.000*	6-Jul	0.266	5-Sep	0.074	5-Nov	*0.000*
6-Jan	*0.000*	7-Mar	*0.000*	7-May	*0.000*	7-Jul	0.257	6-Sep	0.073	6-Nov	*0.000*
7-Jan	*0.000*	8-Mar	*0.000*	8-May	*0.000*	8-Jul	0.249	7-Sep	0.071	7-Nov	*0.000*
8-Jan	*0.000*	9-Mar	*0.000*	9-May	*0.000*	9-Jul	0.245	8-Sep	0.065	8-Nov	*0.000*
9-Jan	*0.000*	10-Mar	*0.000*	10-May	*0.000*	10-Jul	0.239	9-Sep	0.064	9-Nov	*0.000*
10-Jan	*0.000*	11-Mar	*0.000*	11-May	*0.000*	11-Jul	0.230	10-Sep	0.064	10-Nov	*0.000*
11-Jan	*0.000*	12-Mar	*0.000*	12-May	*0.000*	12-Jul	0.222	11-Sep	0.061	11-Nov	*0.000*
12-Jan	*0.000*	13-Mar	*0.000*	13-May	*0.000*	13-Jul	0.215	12-Sep	0.059	12-Nov	*0.000*
13-Jan	*0.000*	14-Mar	*0.000*	14-May	*0.000*	14-Jul	0.208	13-Sep	0.057	13-Nov	*0.000*
14-Jan	*0.000*	15-Mar	*0.000*	15-May	*0.000*	15-Jul	0.201	14-Sep	*0.055*	14-Nov	*0.000*
15-Jan	*0.000*	16-Mar	*0.000*	16-May	*0.000*	16-Jul	0.196	15-Sep	*0.053*	15-Nov	*0.000*
16-Jan	*0.000*	17-Mar	*0.000*	17-May	*0.000*	17-Jul	0.192	16-Sep	*0.051*	16-Nov	*0.000*
17-Jan	*0.000*	18-Mar	*0.000*	18-May	*0.000*	18-Jul	0.190	17-Sep	*0.049*	17-Nov	*0.000*
18-Jan	*0.000*	19-Mar	*0.000*	19-May	*0.000*	19-Jul	0.179	18-Sep	*0.046*	18-Nov	*0.000*
19-Jan	*0.000*	20-Mar	*0.000*	20-May	*0.000*	20-Jul	0.175	19-Sep	*0.044*	19-Nov	*0.000*
20-Jan	*0.000*	21-Mar	*0.000*	21-May	*0.000*	21-Jul	0.171	20-Sep	*0.042*	20-Nov	*0.000*
21-Jan	*0.000*	22-Mar	*0.000*	22-May	*0.000*	22-Jul	0.169	21-Sep	*0.040*	21-Nov	*0.000*
22-Jan	*0.000*	23-Mar	*0.000*	23-May	*0.000*	23-Jul	0.164	22-Sep	*0.038*	22-Nov	*0.000*
23-Jan	*0.000*	24-Mar	*0.000*	24-May	*0.000*	24-Jul	0.165	23-Sep	*0.035*	23-Nov	*0.000*
24-Jan	*0.000*	25-Mar	*0.000*	25-May	*0.000*	25-Jul	0.165	24-Sep	*0.033*	24-Nov	*0.000*
25-Jan	*0.000*	26-Mar	*0.000*	26-May	*0.000*	26-Jul	0.158	25-Sep	*0.031*	25-Nov	*0.000*
26-Jan	*0.000*	27-Mar	*0.000*	27-May	*0.000*	27-Jul	0.159	26-Sep	*0.029*	26-Nov	*0.000*
27-Jan	*0.000*	28-Mar	*0.000*	28-May	*0.000*	28-Jul	0.154	27-Sep	*0.027*	27-Nov	*0.000*
28-Jan	*0.000*	29-Mar	*0.000*	29-May	*0.000*	29-Jul	0.153	28-Sep	*0.024*	28-Nov	*0.000*
29-Jan	*0.000*	30-Mar	*0.000*	30-May	*0.000*	30-Jul	0.148	29-Sep	*0.022*	29-Nov	*0.000*
30-Jan	*0.000*	31-Mar	*0.000*	31-May	*0.000*	31-Jul	0.142	30-Sep	*0.020*	30-Nov	*0.000*
31-Jan	*0.000*	1-Apr	*0.000*	1-Jun	*0.000*	1-Aug	0.137	1-Oct	*0.018*	1-Dec	*0.000*
1-Feb	*0.000*	2-Apr	*0.000*	2-Jun	*0.000*	2-Aug	0.133	2-Oct	*0.016*	2-Dec	*0.000*
2-Feb	*0.000*	3-Apr	*0.000*	3-Jun	*0.000*	3-Aug	0.129	3-Oct	*0.013*	3-Dec	*0.000*
3-Feb	*0.000*	4-Apr	*0.000*	4-Jun	*0.000*	4-Aug	0.126	4-Oct	*0.011*	4-Dec	*0.000*
4-Feb	*0.000*	5-Apr	*0.000*	5-Jun	*0.001*	5-Aug	0.121	5-Oct	*0.009*	5-Dec	*0.000*
5-Feb	*0.000*	6-Apr	*0.000*	6-Jun	*0.015*	6-Aug	0.116	6-Oct	*0.007*	6-Dec	*0.000*
6-Feb	*0.000*	7-Apr	*0.000*	7-Jun	0.161	7-Aug	0.114	7-Oct	*0.005*	7-Dec	*0.000*
7-Feb	*0.000*	8-Apr	*0.000*	8-Jun	0.261	8-Aug	0.111	8-Oct	*0.002*	8-Dec	*0.000*
8-Feb	*0.000*	9-Apr	*0.000*	9-Jun	0.305	9-Aug	0.110	9-Oct	*0.000*	9-Dec	*0.000*
9-Feb	*0.000*	10-Apr	*0.000*	10-Jun	0.317	10-Aug	0.110	10-Oct	*0.000*	10-Dec	*0.000*
10-Feb	*0.000*	11-Apr	*0.000*	11-Jun	0.325	11-Aug	0.108	11-Oct	*0.000*	11-Dec	*0.000*
11-Feb	*0.000*	12-Apr	*0.000*	12-Jun	0.328	12-Aug	0.103	12-Oct	*0.000*	12-Dec	*0.000*
12-Feb	*0.000*	13-Apr	*0.000*	13-Jun	0.334	13-Aug	0.101	13-Oct	*0.000*	13-Dec	*0.000*
13-Feb	*0.000*	14-Apr	*0.000*	14-Jun	0.335	14-Aug	0.098	14-Oct	*0.000*	14-Dec	*0.000*
14-Feb	*0.000*	15-Apr	*0.000*	15-Jun	0.338	15-Aug	0.093	15-Oct	*0.000*	15-Dec	*0.000*
15-Feb	*0.000*	16-Apr	*0.000*	16-Jun	0.340	16-Aug	0.090	16-Oct	*0.000*	16-Dec	*0.000*
16-Feb	*0.000*	17-Apr	*0.000*	17-Jun	0.341	17-Aug	0.086	17-Oct	*0.000*	17-Dec	*0.000*
17-Feb	*0.000*	18-Apr	*0.000*	18-Jun	0.345	18-Aug	0.085	18-Oct	*0.000*	18-Dec	*0.000*
18-Feb	*0.000*	19-Apr	*0.000*	19-Jun	0.348	19-Aug	0.082	19-Oct	*0.000*	19-Dec	*0.000*
19-Feb	*0.000*	20-Apr	*0.000*	20-Jun	0.347	20-Aug	0.080	20-Oct	*0.000*	20-Dec	*0.000*
20-Feb	*0.000*	21-Apr	*0.000*	21-Jun	0.354	21-Aug	0.076	21-Oct	*0.000*	21-Dec	*0.000*
21-Feb	*0.000*	22-Apr	*0.000*	22-Jun	0.358	22-Aug	0.075	22-Oct	*0.000*	22-Dec	*0.000*
22-Feb	*0.000*	23-Apr	*0.000*	23-Jun	0.359	23-Aug	0.079	23-Oct	*0.000*	23-Dec	*0.000*
23-Feb	*0.000*	24-Apr	*0.000*	24-Jun	0.359	24-Aug	0.081	24-Oct	*0.000*	24-Dec	*0.000*
24-Feb	*0.000*	25-Apr	*0.000*	25-Jun	0.357	25-Aug	0.080	25-Oct	*0.000*	25-Dec	*0.000*
25-Feb	*0.000*	26-Apr	*0.000*	26-Jun	0.353	26-Aug	0.079	26-Oct	*0.000*	26-Dec	*0.000*
26-Feb	*0.000*	27-Apr	*0.000*	27-Jun	0.346	27-Aug	0.079	27-Oct	*0.000*	27-Dec	*0.000*
27-Feb	*0.000*	28-Apr	*0.000*	28-Jun	0.338	28-Aug	0.082	28-Oct	*0.000*	28-Dec	*0.000*
28-Feb	*0.000*	29-Apr	*0.000*	29-Jun	0.331	29-Aug	0.083	29-Oct	*0.000*	29-Dec	*0.000*
29-Feb	*0.000*	30-Apr	*0.000*	30-Jun	0.323	30-Aug	0.083	30-Oct	*0.000*	30-Dec	*0.000*
1-Mar	*0.000*	1-May	*0.000*	1-Jul	0.313	31-Aug	0.082	31-Oct	*0.000*	31-Dec	*0.000*

Note: Estimated values are italicized